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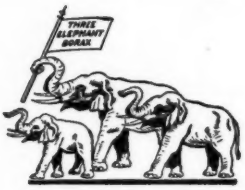

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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*
Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXVIII NO. 1

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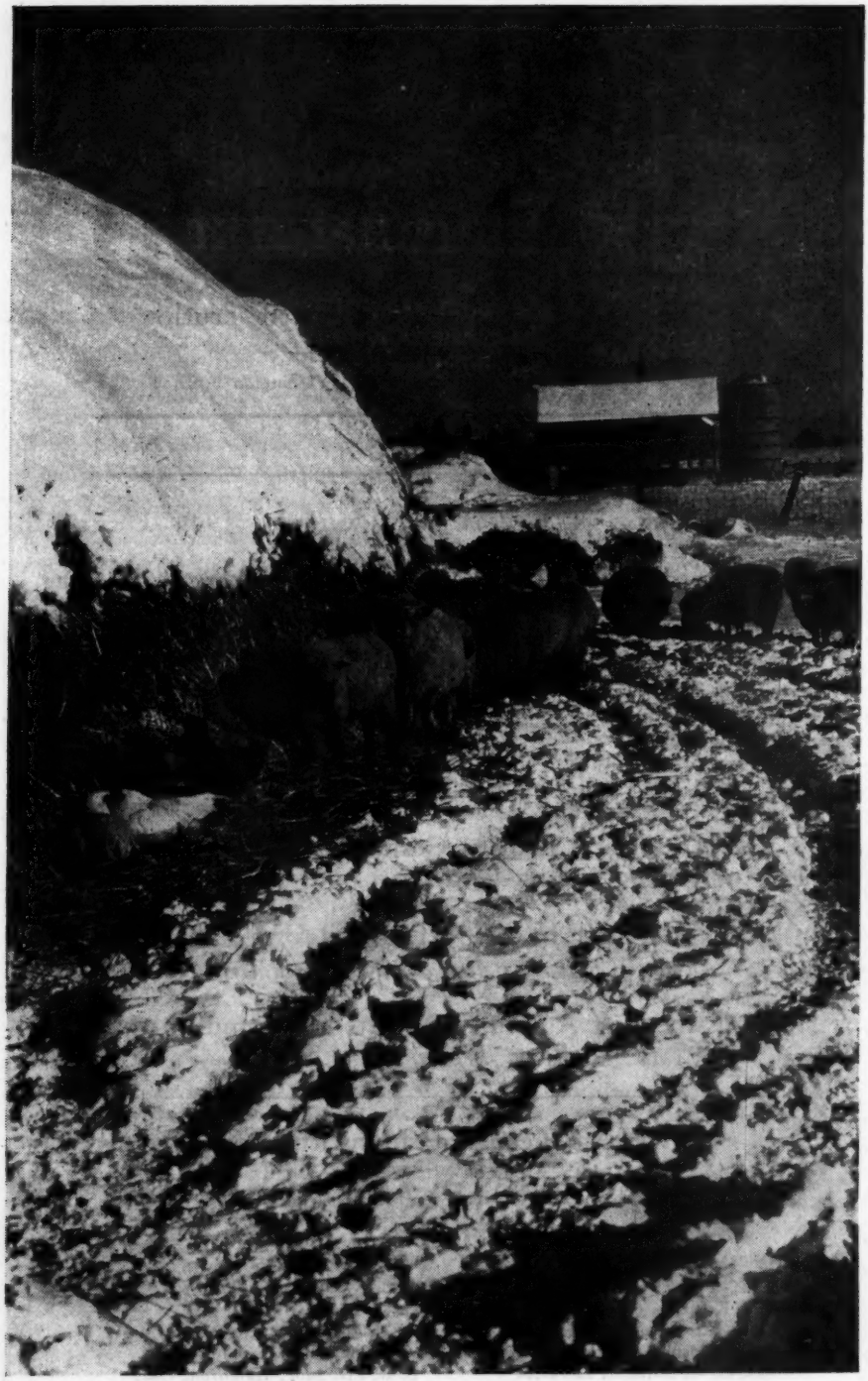

THE SUNNY SIDE OF THE STACK ON A JANUARY DAY

Better Crops with PLANT FOOD

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VOL. XXVIII WASHINGTON, D. C., JANUARY, 1944 No. 1

Looking ahead and analyzing

Victory Vows

Jeff McDermid

NOT an enemy aircraft has showered us with missiles, but the impact of an exploding world has left bomb craters a-plenty in the smug crust of our erstwhile isolation. Our problem now is whether to hide in them or build something better where the wounds exist. My "Americana" impressions, such as they are, come straight, being native and natural and not acquired by adoption or confused by travels abroad. I've always lived in a community that blends commerce, college, and crops—dollar diplomacy, book theory, and bucolic single-mindedness, woven into a typical crazy quilt on the Midwest pattern.

Beginning on a small farm, then to a country court-house town, and finally to a city with a noted campus at one end and a stock-yards at the other with a few factories in between, I have had a chance to watch the sparks fly from clashing opinions and moss-grown prejudices.

Ours is a silo and smoke-stack sky line, bordered by corn tassels and alfalfa blossoms—a queer intermingling which I suppose is not so often seen in the foreign countries we kept so long at arm's length while holding our noses with the other.

We had our weekly commerce club gabfests, our frequent farm emergency sessions over this and that alarm roused by modern horseless Reveres, no end of research by science, debates by solons, and strong demands pro and con by capital and labor.

Pencil in hand and ears dug out for news tidbits, your faithful scribe has

lived through all such experiences without losing faith in what some folks call our "destiny," despite everybody hollering at once for some small corner on what little there was left. Probably, I am unique in this retention of a disinterested attitude, not belonging to anything special or having much of anything valuable belonging to me. It's often been a lonesome thing in a way, this always being a watcher on a removed vantage point with no strings tied to my big toe or wearing no man's brass collar.

I GUESS that men and women who took sides to protect their privileges have had more income and made more "profitable" relationships over the pre-war years, but they haven't had any more fun than yours respectfully.

With this preface I will set down a few of the changes of attitude which seem necessary and advisable if we are to render substantial aid to world "salvation," according to our traditional "destiny."

Just to prove I'm no stuffed owl about this business, I'll whack my own profession first and foremost. We have usually rushed our petty foibles and half-cooked hunches to the linotype department before the community had time to cool off or sober down after a dent was made in our traditional way of life. We've dished out nasty doses of criticism we wouldn't take ourselves. We've hugged our provincial pride so tight we couldn't see the next town for sour grapes, and we've ruined the reputations of everybody we had a peeve against, from the garbage hauler to the peer of Great Britain.

Sumner Welles has lately written considerable good stuff in favor of every country maintaining freedom of thought and freedom of expression through press and radio. He says that's not trying to force our republican form of government on anybody, but it's just giving ventilation and fumigation a chance to do its work—but of course not in just those words.

I infer that he rightly thinks that suppression and distortion of facts are bad for mental and moral health. I shout "amen" to that indeed, but at the same time the weakness and cupidity of some members of my own writing clan and their connivers, the publishers and broadcasters, cannot be checked merely by "free speech" privileges. Too many publicists have more to fear from lack of a sound conscience than from an iron-clad gag rule. It must be seen that the future depends more on the capacity and strength of our information service to learn self-control in the public welfare than it does on laws and regulations. In order to be entirely free and subject to decent self-regulation, publicity must divorce itself from financial and commercial exploitation. So you see in the realm of news and commentary we still have some medicine to take, without worrying about quick cures for foreigners and savages. We don't have to send a high-priced correspondent abroad to get a feature story on reform.

Having demonstrated that the press and radio needs to undergo some change of attitude, we can turn to a few other instances of a less class-restricted kind.

IT'S certainly a queer mixup and right-about-face when you stop to think about Midwest attitudes toward militarism and naval power, now and five years ago. Last month I heard some authority say that three or four of my familiar central states, land bound and isolated from the ocean's influence, had contributed more gobs and tars to the decks and gunrooms of our navy than any other area. I recall with clarity the debates in our legislature against compulsory military drill in the state university, and the way the solons regarded expenditures for battleships as just so much foolish waste.

And now numbers of those chaps have graduated into congress or taken posts in other government work. Today they help launch battleships with champagne and brag long and loudly about the victories afloat.

To me this is not anything for conjecture or amazement. I see the reason for it like you do, but what I wonder about is how long will our political leaders and economic bosses continue to maintain this frame of mind after the last shot is fired. Public employment absorbs nearly ten per cent of our total population, if we include sailors and soldiers in the category. Naturally, as long as this means of livelihood occupies so many of our citizens, you'll find the voice of influence raised in support of armament and defense. But how about the opinions of leaders when everyday humdrum home jobs become once more the main avenue for subsistence?

If insulated provincialism dies and stays dead as a result of our living in a smaller world, it may prevent the re-awakening of that same old "beat-all-swords-into-plowshares" instinct. A lot also depends on what kind of trading dickers we can reach a compromise on. Judging by the sayings and doings not so long ago by some of our het-up pressure boys against the Hull reciprocal treaties, we are going to be in for a lot of gallery guff and lobby log-rolling before we can arrange for a satisfactory agreement on overseas commerce, tariffs, and exchanges. The war won't end the smoke screens by any means.

Anyhow as I go about hither and yonning, I see that the state of mind of my cronies has reached a pass where they are not indulging in wishful thinking or being so complacement as we hear Washington experts say. Rather than see heaps of the boys and girls mustered out to take rag-tag jobs and humiliating charity in the wake of a depression, most of them have told me they hope the mustering out process will not be too sudden. They vision a need for soldiering and sailing for some time after the diplomats settle what the generals have spared. Some of their sons have got quite used to wearing officers' emblems and having some degree of impersonal authority and a sense of national dignity. Others have acquired special skills that won't be so much use after the war unless the jobs are more numerous than we imagine possible. Still others will develop a wanderlust and a hatred of confinement in uninteresting jobs and tiresome places

My friends, the parents of service men, also think that the diplomats and food hand-outers will not be sure to succeed in paving the way for the dove of peace to build its nest in blasted countrysides. They think we'll have to tote the big stick and the lariat, even if we lay aside firearms. And all this home-made thinking winds up to the answer that they want their boys back all right, but not until the job is done so it will stay done. Their love of uniforms for the sake of gaudy display and glory is not any stronger than it was when the Populists toured the prairies and the Peace-At-Any-Price mania claimed us for its own. But they admire grit and stamina, they have the American habit of winning, and organizing thoroughly to get something accomplished quick. Hence they refuse to unthink themselves now, after so much painful reshaping of their pet doctrines. So they are in it to see it through, come drought or high water!

The first guy who pops up in congress or my own state assembly to gurgle out namby-pamby nonsense about waste in militarism amid the aftermath of victory is due to be elected to retire. Our folks were fooled once,

(*Turn to page* 51)

Potatoes fertilized with one ton of 4-16-14. Yield per acre 560 bushels. To make sure of high yields, ample fertilizers must be applied.

Where Do We Stand With Fertilizers?

By Ford S. Prince

University of New Hampshire, Durham, New Hampshire

IN times like these, when almost anything can happen, it is well to pause oftentimes to see where we stand. Take this matter of fertilizers. We have already experienced a period of nitrogen shortage. We assume what with new synthetic plants in operation, that this won't happen again. This year we are faced with a tight potash situation due to the greatly expanded demands being put upon our domestic supplies. These supplies are far from consuming centers. A transportation breakdown, a protracted strike, or a well-directed enemy bombing attack, any one of these things could create a very serious situation with potash. There are a great many things, no doubt, that could happen to our superphosphate supply.

Let us suppose then, for purposes of illustration, that one of these critical fertilizer ingredients will be so short that it can be obtained only in limited quantities or not at all. Where would the dairyman stand? Or the potato grower? In other words what is the effect of each one of these elements upon crop production?

Last spring when nitrogen was reduced 20 per cent in all fertilizer grades and even more in the Victory Garden Special, there was considerable talk about the "poor" fertilizer that had to be used. Yet no victory garden failures have come to our attention. At

harvest time, many potato growers in New Hampshire tried to place the blame for poor yields on the lack of nitrogen in the fertilizer. But as Maine growers produced bumper acre yields, we must conclude that low yields in New Hampshire should be blamed largely upon the weather and not upon fertilizer quality, since Maine growers used the same quality of fertilizers as did our farmers.

We have made an attempt in New Hampshire when publishing results of research to evaluate separately the effects of the three fertilizer nutrients. In each case these results have applied to specific crops or to pastures. In this article we will make an attempt to summarize these values so far as possible for the entire range of field crops in which we are interested at the moment.

Take the potato crop which was under study in New Hampshire for 12 years in one location and 6 years in another, with fertilizer tests similar in both cases (1).* Potatoes were grown without nitrogen or phosphoric acid or potash, then each element was doubled and all six treatments were compared with a standard check which happened to be a 4-8-7 grade, one ton per acre.

The average yield of these two tests, one of which was conducted in northern, the other in southern New Hampshire, was 312 bushels of potatoes per acre. Variations from this check plot yield where the two sets of figures are combined were as follows:

TABLE I.

Grade of Fertilizer	*Variation from Check, Bu. per A.*
0–8–7	−17
8–8–7	+12.5
4–0–7	−68.5
4–16–7	+32.5
4–8–0	−102
4–8–14	+26

Leaving out an element always depressed the yield as might be supposed. Conversely, doubling an element always increased the yield. Omitting an element caused a greater depression in yield per unit of fertilizer than a similar amount of fertilizer increased the yield.

Turning these figures around, we may say that the first four units of nitrogen returned 17 bushels while the second four boosted the yield only 12.5 bushels. Similar results for phosphoric acid, for the first eight units were 68.5 bushels and for the second eight 32.5 bushels, while for potash the results were 102 and 26 bushels respectively.

In Table II we have presented the average response of these fertilizer ingredients when used in amounts below or above the check plot application. The response per unit has been calculated directly; potatoes have been figured at $2.25 per hundredweight; and fertilizer costs at $40 per ton for sulphate of ammonia, $25 per ton for 20 per cent superphosphate, and $48

* Numbers in parentheses refer to literature cited.

TABLE II. UNIT VALUE OF FERTILIZER NUTRIENTS ON POTATOES

	Gain for First Increment per unit, bushels	Value	Cost of Fertilizer	Net Gain
N	4.25	5.74	2.00	3.74
P_2O_5	8.56	11.56	1.25	10.31
K_2O	14.57	19.67	.80	18.87
	Gain for Second Increment per unit, bushels			
N	3.12	4.21	2.00	2.21
P_2O_5	4.06	5.48	1.25	4.23
K_2O	3.71	5.01	.80	4.21

per ton for muriate of potash, 60 per cent grade. The potato price used presumably represents the floor price for the current season. These figures all vary somewhat from actual values but are close enough to actuality for purposes of comparison.

Results reported by Chucka, Hawkins, and Brown (2) from the Maine Station place less emphasis upon phosphoric acid and even more upon potash than those discussed in detail from New Hampshire. This difference in phosphorus response is no doubt due to the more intensive system followed in growing potatoes in Maine and to an accumulation of phosphoric acid in the soil from repeated applications of fertilizer.

In the reference cited, (table 9, p. 132), date covering 12 years of work are available.

In Table III the variations in yield from the check plot are presented. One ton of fertilizer was applied in each case, the check plot receiving one ton of a 4-8-7 grade.

TABLE III.

Treatment	*Bushels per Acre*
0–8–7	−84
2–8–7	− 9
6–8–7	3
4–0–7	−103
4–4–7	1
4–8–0	−248
4–8–4	−26
4–8–10	19

The yield variations are somewhat wider than those of New Hampshire where elements are omitted. This is to be expected since total yields are higher, and under conditions that produce high yields, variations will always be wider. Differing from New Hampshire, however, are the responses for increasing the nitrogen and phosphoric acid. In these Maine data very little increase in potato yield was noted when nitrogen was increased to over two per cent, and there was no increase for amounts of more than four per cent of phosphoric acid in the fertilizer.

With potash, however, increases were secured when as much as 14 per cent of this element was included in the fertilizer. In this respect the data are much like those of New Hampshire. The fundamental difference then is the lack of response to phosphorus in the Maine potato-growing systems.

Connecticut (3) results show a decrease of 78 bushels for omitting nitrogen and no increase for amounts over 100 pounds of elemental nitrogen per acre. They also indicate a decrease of 103 bushels for leaving phosphoric acid out of the formula, with no gain for increasing this element to more than 160 pounds per acre. Omitting potash caused a decrease of 121 bushels, with no yields higher than those produced with 120 pounds of this element in a balanced fertilizer.

If we look at the research data from all three states as a unit we find that omitting nitrogen, phosphoric acid, or potash caused decreases on the average of about 20, 30, and 50 per cent respectively, when fertilized normally otherwise and compared with check plot yields. These percentages give some idea of the importance of the three elements and their influence on potato production.

It would be very gratifying in presenting data of this sort if we could predict accurately what each added increment of plant food would return in crop yields. There are some reasons why this cannot be done. In the first place, we haven't all the data; and in the second, the old law of diminishing returns steps in to give the first increment greater influence than the second and so on.

The data from Maine, however, are fairly complete on this point, the nitrogen having been increased two units, while phosphoric acid was stepped up four units and potash from zero to four to seven, then to 10 and 14.

The first two units of nitrogen in these Maine tests gave 80 per cent of the increase recorded for nitrogen, up to a total of six units. The second two units gave nine per cent of the increase,

Potatoes fertilized normally with one ton of 4-8-7.

while the third two units gave 11 per cent, the total increase being 105 bushels for nitrogen.

The first four per cent of phosphoric acid gave all of the increase in the Maine results.

With potash, 81 per cent of the increase came from applying the first four units, nine per cent from the next three, six per cent from the next three, and four per cent for boosting the amount from 10 to 14 units.

The results for nitrogen in the three references cited are fairly consistent, and it seems fairly accurate to say that good corps of potatoes can be produced with 80 pounds of nitrogen, the maximum being reached with around

Potatoes fertilized with 4-8-0. (Photographs taken on same day.)

A mixed stand of clover and timothy: left, check, unfertilized; right, fertilized with K. Livingston farm, Claremont, N. H. First cutting 1938.

100 pounds of nitrogen per acre.

In New Hampshire, good crops of potatoes can be predicted where 160 pounds of phosphoric acid are used, but maximum crops need a slightly higher phosphorus level, probably 240 pounds per acre. In Connecticut, maximum yields can be obtained by using 160 pounds and in Maine by using 80 pounds, although 120 are recommended for safety.

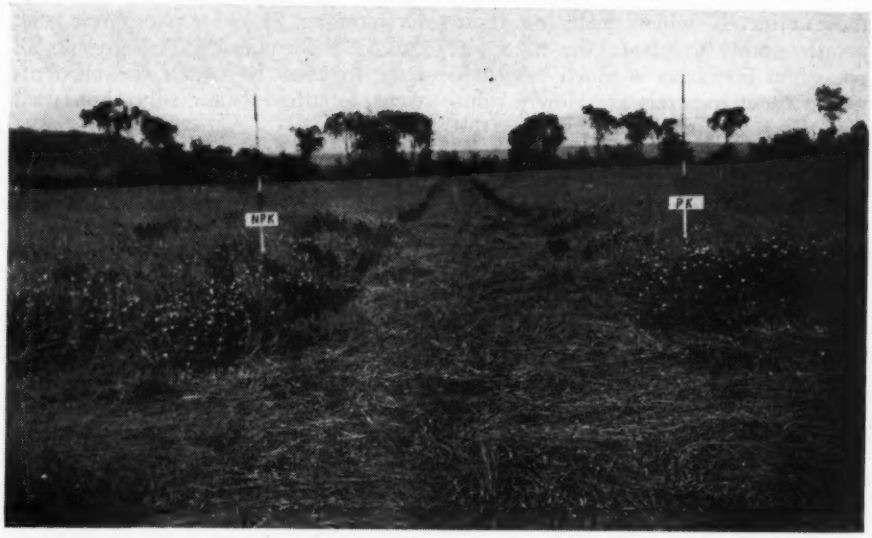
One hundred and twenty pounds of potash appear to produce maximum crops of potatoes in Connecticut, but in New Hampshire and Maine maximum crops need at least 240 pounds, although good crops are produced at a somewhat lower level.

I have summarized data for the potato crop first in this article because almost 50 per cent of the mixed fertilizer used in New England goes to potatoes. Of even more importance to more people in New England is the fertilizer used on forage crops. Of the total fertilizer used almost 18 per cent is applied to hay crops and 13 per cent to pastures, making the impressive total of nearly one third of all fertilizer consumed going to this crop group.

Much research work has been done to indicate what response is likely to be secured from using fertilizer nutrients singly or combined on hay and pasture plants. The crops naturally divide themselves into grasses and legumes in any fertilizer discussion since grasses are more responsive to nitrogen and the legumes to potash and phosphoric acid.

Take grass hay, as an example. We have found in New Hampshire (4) that nitrogen is the biggest limiting factor to high yields, but that the response from nitrogen will be reduced when there is a deficiency of phosphoric acid and potash in the soil. Where this is the case the response from phosphoric acid and for potash will be increasingly greater. In other words, grass hay fields amply supplied with these two elements will continue, for a year or two at least, to yield well with nitrogen alone, but without available supplies of phosphoric acid and potash in the soil a complete fertilizer must be applied. This forms the basis for the 1-1-1 fertilizer ratio which is almost universally accepted as the correct one for top-dressing grass hay lands.

In our work in New Hampshire, in



A mixed stand of clover and timothy: left, fertilized with NPK; right, PK. Livingston farm, Claremont, N. H. First cutting 1938.

which hay lands have been top-dressed with nitrogen alone and with a fertilizer approximating a 1-1-1 ratio, the results have been somewhat varied, and colored by past soil treatment. In one test on a soil in which neither phosphoric acid nor potash were limiting factors, an application of 32 pounds of nitrogen in nitrate of soda brought a response of 1,462 pounds of cured hay per acre, while the same number of pounds each of phosphoric acid and potash caused an increase of 728 pounds. When a complete fertilizer equal to the two separate treatments was applied, the increase was 2,159 pounds. The treatments were all applied at a gain of more than double the fertilizer costs.

In a similar test on a very heavy soil which was seriously deficient in both phosphoric acid and potash, 32 pounds of nitrogen gave an increase of about 600 pounds of hay while a complete fertilizer with 32 pounds of each of the elements gave an increase of 1,600 pounds.

A search of the literature reveals many interesting trials where fertilizers or manure and superphosphate have been used. The results all vary in extent but differ little in trend. They all point to one significant fact, that there is nothing more certain than that nitrogen applied to a straight grass crop will stimulate growth. The extent of the increase, or, stated in another way, the utilization of this nitrogen, will be governed by the amount of available phosphoric acid and potash in the soil. Unless it is known that these elements are present in the soil in amounts so as not to become limiting factors, a complete fertilizer should always be used.

With alfalfa and the clovers the story is entirely different. In fact potash stands in the same place with legumes as nitrogen does with the grasses. The extent then that potash fertilizers are required to produce maximum crops is governed by the amount of available potash in the soil or that which can be made readily available during the growing season.

It is a well-known fact that although the supply of total potash in mineral soils is very large, there is only a small percentage of it available at any one time. Also, that potash in certain minerals is much more usable than it is in others. If soils have been formed from

those minerals which yield up their potash readily to plants, the need for potassium fertilizers is much less than where these minerals are slowly soluble. This fact no doubt explains the differences noted in potash response when studying results from widely separated experiments over the United States.

It would appear that native New England minerals yield up their potash slowly in plant growth. Further the reversion of applied potash to native mineral forms is probably higher here than it is in many other places, thus establishing a fairly strong need for potassium in the fertilizer for the groups of crops under discussion. The greater the feeding power (or the larger the crops which are produced), the greater is that need. Nor do we mean to minimize the need for phosphoric acid, and likewise, we must assume that the lime requirement must be met for the crop to be grown. This latter fact, however, only emphasizes the need for potassium in the fertilizer.

Financial Returns from Potash

To be more specific, alfalfa and ladino clover, both rapid growing and highly productive crops, have a high potash requirement. The comparative need in relation to yield is doubtless just as great for the other clovers.

This is well illustrated by the results of research work in our own as well as some of the other New England States. In one report dealing with alfalfa (5) one dollar invested in potash gave a return of four dollars in hay, and compared with $3.50 per ton returns for manure applied at a 20-ton rate. Superphosphate applied at the rate of 500 pounds of 16 per cent superphosphate barely managed to pay its cost and then only with heavy manure applications. Nitrate of soda did pay its way applied at the light rate of 100 pounds per acre.

In another test on the same field (6) in which the alfalfa seeding was further from a manure application, the returns per dollar invested were $2.29 for nitrogen, $1.39 for phosphoric acid, and $3.72 for potash. These results all refer to cases in which the elements were top-dressed annually, but used singly.

Soils of the Connecticut Valley have given good response to fertilizers containing potash in growing legumes. Our preliminary work in this area was with a mixed stand of alfalfa and timothy (7). With hay and fertilizers calculated at normal values, one dollar invested in nitrogen, used with phosphoric acid and potash returned $3.89 in hay. One dollar invested in phosphorus returned $0.97 when used alone, $1.63 used with potash, and $1.79 used with lime and potash. One dollar invested in potash returned $3.07 used alone, $4.78 used with lime, $3.76 used with phosphorus, and $5.93 used with both lime and phosphorus. All of this work pointed to a need for fertilizer balance as can readily be seen.

In other work on this field (7) (8) red and alsike clover were grown either alone or in mixtures. An average of eight crops ascribes a gain in hay values of $1.74 for the use of 100 pounds of nitrate of soda, only $0.41 for 400 pounds of 20 per cent superphosphate, but $9.53 for the use of 125 pounds of 60 per cent muriate of potash. When the superphosphate and potash treatments were combined, the gain was $27.00, again indicating the need for balance so far as phosphoric acid and potash are concerned.

One of the significant phases of this work in the Connecticut Valley has been the persistence of red clover over a period of years in all plots treated with potash, no matter what other treatment was employed. In a seeding made in 1938, this species still exists in the stand and good yields of hay are still being cut. Work is now under way to determine how much potash must be used to secure this effect, also how long the red clover will continue to occupy a fair percentage of the hay stand with the requisite fertilization.

(*Turn to page* 49)

What's in that Fertilizer Bag?[1]

By Vincent Sauchelli, Agronomist
The Davison Chemical Corporation, Baltimore, Maryland

THE manufacturer uses a formula just as a cook uses a recipe. It tells the plant foreman the kinds and amounts of the various materials to use in preparing the complete mixed fertilizer. The formulas used by different manufacturers are not usually disclosed; they may be "trade secrets." Most laws do not require a disclosure. Some manufacturers voluntarily furnish this information on the bag or on a tag affixed to the bag. Such a formula, so disclosed, is called an "open" or "public formula."

The analysis or grade of fertilizer refers to the percentage of nitrogen, phosphoric acid, and potash present without reference to the source of the nutrients.

The analysis is always in whole numbers and the plant foods are always stated in the same sequence, namely: N, P_2O_5, K_2O. For example, 3-12-6 means 3% nitrogen, 12% phosphoric acid, and 6% potash.

Different formulations for the same grade or analysis are possible. The experienced manufacturer knows how to choose the proper materials and so formulate them that the final product will have the required analysis and ratio and be properly conditioned; that is, it will not cake or lump, and neither be too moist nor too dry; in short, be "well cured" and easily drillable—qualities which the modern farmer takes for granted.

Let us consider 2-12-6 as an example because it is a very popular grade. How is it formulated? What goes into a 100-pound bag?

The manufacturer could use a very simple mixture, comprising muriate of potash 60% K_2O, sulfate of ammonia 20.5% N, and superphosphate 20% P_2O_5 with some filler. This is the most simple form. It is diagrammed at the left in Fig. 1. Experience has shown that this is not a practicable formulation where the fertilizer is to be stored any length of time in bags. The commercial fertilizer manufacturer is more likely to use the more typical formulation given in the diagram at the right in Fig. 1.

Some growers insist on more than one source of nitrogen. In this particular formulation three nitrogen carriers are used: sulfate of ammonia, ammonia solution, and tankage. Many farmers prefer a neutral or nonacid-forming fertilizer. In the formula on the left (Fig. 1) 9.8 pounds of sulfate of ammonia furnishing a little less than 2 pounds of nitrogen require the equivalent of about 10 pounds of calcium carbonate to neutralize the potential acidity. (One unit of nitrogen requires 107 pounds of calcium carbonate to neutralize potential acidity.) The bag contains 20 pounds of dolomite, which furnishes more than enough lime to neutralize the acidity. The formulation on the right (Fig. 1) requires 3.8 pounds of dolomite in each bag to neutralize the potential acidity of the nitrogen carriers. As it stands it is practically neutral.

Let us take another example, this time a 3-12-12 fertilizer which is also popular. Several formulations are possible. The simplest is illustrated in the

[1] The second of two articles.

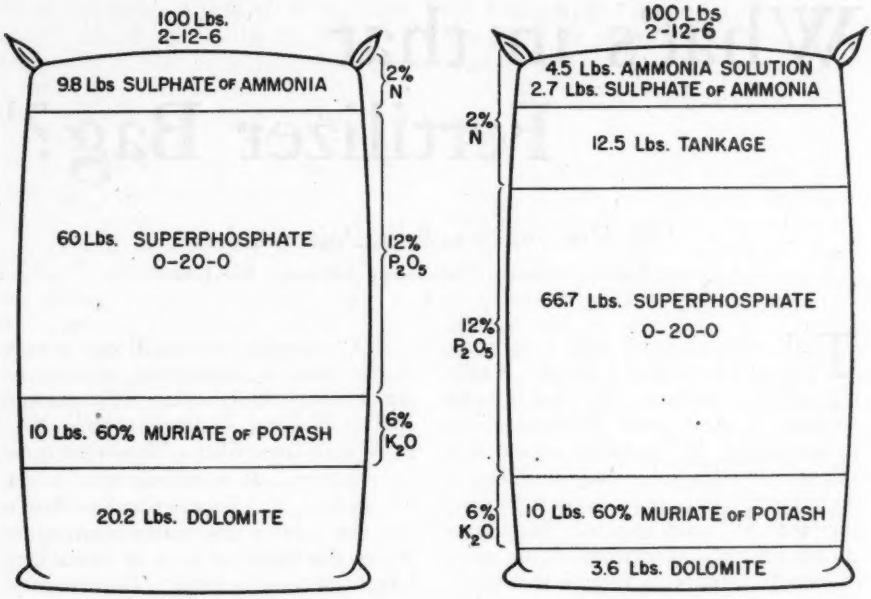


diagram on the left (Fig. 2). Again the fertilizer manufacturer is more likely to use a mixture as represented in the diagram on the right (Fig. 2.)

The first formula is acid-forming; it has an acidity equivalent to 15.5 pounds of dolomite and only 5.3 pounds could be added. Room could be made for more dolomite by replacing some of the 20% superphosphate with triple superphosphate.

The formulation shown on the right in Fig. 2 requires about 10 pounds of dolomite to make it nonacid-forming. To make room for the dolomite, the manufacturer had to select and combine different nitrogen carriers and some ammophos 11-48-0. These adjustments required skill and experience in order to produce a good commercial material that would remain in good mechanical condition over a reasonable length of time. The manufacturer has to prepare a large amount of a fertilizer mixture months in advance of its use so as to have it "well-cured" if it is to be acceptable two or three months later. It used to be that the farmer bought his fertilizer early in the season and put it in his barn until needed. Today under normal conditions he expects to phone the same day the weather forecast is favorable and have the fertilizer delivered right to the field. The manufacturer has to prepare his mixtures well in advance and have them stored and ready for shipment to give this service. I mention this to emphasize the importance of knowledge and experience in choosing and blending materials so as to give the farmer a thoroughly satisfactory product on short notice.

Every state has laws which require the manufacturer to print on the bag or on an attached tag a guarantee as to the plant-food content of the fertilizer. Such a printed statement is the "guaranteed analysis." Nowadays the guaranteed analysis or grade is quite simple, usually stating the percentage of the nitrogen, the available phosphoric acid as P_2O_5, and the available potash content as K_2O. These three plant foods constitute the composition and value for which the purchaser is paying.

Occasionally despite the greatest precaution, there may be a fertilizer bag in which the material is sticky, or moist,

or as hard as a rock. The reason for it is that the fertilizer was not properly "cured" before it was shipped. For example, many manufacturers make up "bases" which are usually mixtures of sulfate of ammonia or muriate of potash and superphosphate. A rapid chemical action ensues when these materials are mixed, forming a hard mass. But it is convenient to have this reaction take place and complete itself in advance of formulation with other materials. The "base" is made into large piles which "set up" or harden; the potash base becoming particularly hard. After a period of time the piles cool off, the chemical reaction is completed, and the "base" is cured and can be broken up, ground, and used with other materials to make a complete fertilizer. Superphosphate must also undergo a "curing" process following the acidulation of rock phosphate with sulfuric acid.

A unit represents one per cent of a ton, or specifically, 20 pounds. For example, in a 3-12-12 fertilizer, we say it contains 3 units of nitrogen, 12 units of phosphoric acid, and 12 units of potash. We could also say and mean the same thing by reading the formula as 3% and 12% and 12% of each respective nutrient. To use actual pounds we multiply the number of units by 20 pounds and read the figures as 60 pounds of nitrogen, and 240 pounds each of phosphoric acid and potash.

What Is pH?

pH is the measure of the degree of acidity or alkalinity. It is a symbol which has proved very convenient to designate the degree or strength of acidity. It does not tell anything about the amount of acidity or alkalinity. As in a thermometer, the scale shows the intensity or degree of heat but does not tell anything about the calories or quantity of heat.

A scale is used on which the figure 7 is the neutral point. Each figure below this represents the intensity of acidity and each figure is 10 times that of the preceding figure. For example, pH 6 is 10 times as acid as pH 7 and pH 5 is 10 times as acid as pH 6, but 10 x 10 or 100 times as acid as pH 7.

Likewise, figures above 7 represent the strength of alkalinity, pH 8 being 10 times as alkaline as pH 7.

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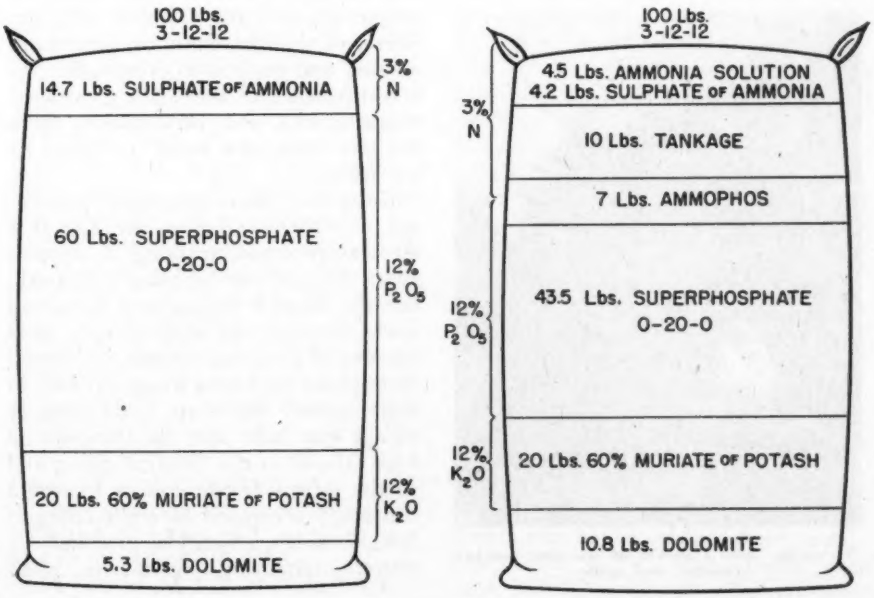

An Agricultural Look at Costa Rica

By Rafael A. Chavarria

San Jose, Costa Rica

COSTA RICA, one of the smallest Central American republics as far as area and population are concerned, is located geographically in the very heart of the American Continent (between 8° and 12° lat. north).

Its political limits are the following: north, Republic of Nicaragua; south, Republic of Panama; east, Atlantic Ocean; and west, Pacific Ocean. Its area is constituted by 48,500 sq. km. of the most diversified land, as far as topography and agronomic characteristics of the soil are concerned. The population is composed of approximately 680,000 inhabitants of Spanish ascendency, with such a small percentage of native Indian blood that it can hardly be recognized. If it were not for a small number of negroes, once imported from Jamaica to work as laborers in the construction of the railway to the Atlantic Ocean, Costa Rica would have no colored people. From the foregoing, it is easy to assume that this little country ranks as one of the first, as far as the purity of its race is concerned, among all those which south of the United States compose the American Continent.

The author amid a growth of mangoes, peaches, avocados, and apples.

The social and political advantages derived from this state of affairs are obvious, and thanks to them, some of the noteworthy characteristics of this country are its peaceful life and the well-disciplined, easily governed, democratic people. Religious problems are unknown, and notwithstanding the fact that the nation and the majority of the people practice the Catholic religion, liberty of thought, faith, and creed are assured and granted to everybody. As a consequence of the above-mentioned characteristics and peculiarities, there has not been any social problems or agitations.

Costa Rica has a very small percentage of illiteracy due to the fact that elementary school training is compulsory. The national language is Spanish, but the English language is becoming quite familiar. In addition to a great number of grammar schools distributed throughout the Costa Rican territory in such manner that there is no town or village that lacks one, there are several high schools in the different cities; and in the capital at San Jose is located a university composed of eight colleges: law, dentistry, education, arts and sciences, engineering, agriculture, phar-

Young stock—the little colt in the foreground is of Peruvian breed.

macy, and political and economic sciences.

Reference has been made to the human element because of the great significance that it has in the study of the agricultural situation of any country.

The principal productive activity of Costa Rica is agriculture. From it is derived the well-being of the largest percentage of the country's population. The land is fairly well distributed among the inhabitants so that practically all Costa Rican farmers own their farms. These farms may vary in size, depending on location and exploitation, from five acres in the most populated and expensive central regions up to several thousand acres in the more distant and less populated ones. Notwithstanding the fact just mentioned, due to the relatively scarce population the greatest part of the territory has not been opened to agriculture. With the exception of a part of the central high plateau which is located at an altitude ranging from two to six thousand feet above sea level and in which the principal and most populated cities are to be found, including the Capital, and with the exception of a northern portion of the Atlantic Coast and lowlands and a part of the Pacific Coastal Plains, the country consists of unexploited and practically uninhabited woodlands.

Climatic conditions are ideal, and this country could have on that account a very prosperous and diversified agriculture. The rainfall varies from one to six thousand millimeters per year according to locality, and is largely distributed from May to December. Rains are less abundant, and in some localities do not exist at all, from January to March. The mean temperature varies from 16 to 28 degrees centigrade according to altitude. The highest rainfall and temperature correspond to the coastal regions. Topography is so diversified that it is easy to find good agricultural lands at every altitude, ranging from zero to almost ten thousand feet over sea level.

Of course, and as may be expected, the existence of such diversified climatic conditions, etc., as well as the previous action of different geological forces has given rise to a great variety of soil types and classes which may run from coarse sand to heavy clays, provided with different amounts of organic matter and with different contents and proportions of available plant nutrients. The soil thickness varies also from 10 to 12 inches, which is common,

to 80 or 100 inches deep. Sub-soils vary as well, and there can be found sandy, clay, or rocky ones. The biological phase of soils is ordinarily active, hence nothing else could be expected from the constant interaction of forces, such as warm climate, sufficient organic matter, and permanent humidity. Thus Costa Rica could very well be considered as the melting pot of the Americas' agricultural treasures. And so ecologically and agronomically—in spite of the smallness of the territory—if properly looked for, there will always be found a good condition for the adaptation and production of practically every agricultural crop of the world.

Therefore, it is natural to expect that agricultural production be diversified, well-balanced, and highly developed. Unfortunately, this is not true. On the contrary, the greatest defects of the agricultural organization of Costa Rica are, besides its relative smallness, the lack of diversification and the absolute absence of a convenient balance or equilibrium, all of which urge the immediate establistment of a well-planned, technical program for the nation's agricultural development.

To give a general idea of what is or could be produced in this country, the most common crops are here mentioned. Corn, rice, beans, and sugar cane are cultivated on a large scale as they constitute a very important part of the rural population's diet; potatoes; cereals other than corn—such as millets, barley, oats, wheat; sweetpotatoes, mandioca or yuca, arrowroot, and other roots and tubers; leguminous crops, other than beans, such as peas and many others; cucurbits and other horticultural crops; flowers of great varieties and species; medicinal plants; oil-yielding crops; fibre plants; small fruits of great varieties; other fruits like citrus, apples, pears, pineapples, papayas, mangoes, avocadoes, etc.

Forage crops of sub-tropical inhabitat such as rye grass, oat grass, orchard grass, alfalfa, clover, etc., and a great number of tropical forages, such as para grass (Panicum barbinode); molasses grass (Melinis minutiflora); Guinea grass (Panicum maximum); giant or elephant (Penisetum purpureum); Bermuda grass (Cynodon dactylon); kikuyo (Penisetum clandestinum); etc.

The principal crops of agricultural production, as far as area cultivated and value of the surplus exportable, are cof-

Growing side by side—bananas, sugar cane, peanuts, sweetpotatoes, etc., a common sight in Costa Rica.

"Volcan Turrialba," an inactive volcano located in the center of Costa Rica. Many subtropical or temperate plants may be found in this splendid dairy region which has an altitude of 7,000 feet or more.

fee, bananas, and cocoa. Of the first one mentioned, there are under cultivation approximately 200,000 acres of very valuable highlands located in the most populated regions of the country in such a way that even the most important city, the capital, is surrounded by coffee plantations.

Not less than 200,000 inhabitants, which means very nearly a third of the Costa Rican population, derive their income from coffee culture. The surplus quantity of coffee harvested is exported to Europe and the United States. It produces an income of thirty to forty million colones per year ($1.00 United States currency equals 5.62 colones). The income obtained from coffee exports represents 50 per cent of the value of the exportable items of Costa Rica. The second major crop is bananas. These are cultivated on the lowlands of the Atlantic and Pacific coasts and their surplus amounts to several million bunches with exportable value of from fifteen to twenty million colones per year, representing 25 per cent of the total exports.

It should be understood that significant places are awarded to these crops in view of their exportable value, and not on account of their general importance to the nation, because others already mentioned, such as corn, rice, sugar cane, etc., need to be regarded simultaneously. In addition, the animal husbandry activities, such as dairying and meat production, can be estimated in over two hundred million colones.

To conclude with this exposition of the agricultural possibilities of Costa Rica, it is worth while mentioning the fact that a growing interest has been evidenced by several U. S. A. government offices connected with the U. S. Department of Agriculture in the promotion of the production of several agricultural goods of great importance and strategic value, such as rubber, fibre, or staple crops particularly manila hemp, medicinal plants such as quinine, etc.

Some Technical Problems

Although inconceivable after what has been claimed in favor of the agricultural advantages and possibilities of Costa Rica, it must be said that little effort has been made, individually or as a nation, to develop in Costa Rica a prosperous, diversified, and well-balanced agriculture capable of yielding the greatest benefit to the largest number and for the longest time.

Perhaps in no other respect is the need of better systems and of a more scientifically planned and conducted agriculture more evident than in regard to the soil problems, such as soil conservation, management, and improvement. As has already been mentioned, practically all Costa Rican soils are capable of production. Of course, there is great variation in geological origin, physical, chemical, and biological characteristics of the soils so that they vary considerably as far as their immediate productivity, potentiality, and total fertility are concerned.

For potentiality and fertility most of the agricultural soils are from fair to good, but many have lost, or very nearly so, their immediate productivity on account of the shortage of available fertilizing or plant-food elements. One of the principal reasons for this shortage is the heavy rate of percolation registered everywhere in Costa Rica and more particularly in those shallow, sandy soils not very rich in organic matter and quite common in the Pacific

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Available Potash in the Surface Soils of Georgia

By L. C. Olson and R. P. Bledsoe

Georgia Agricultural Experiment Station, Experiment, Georgia

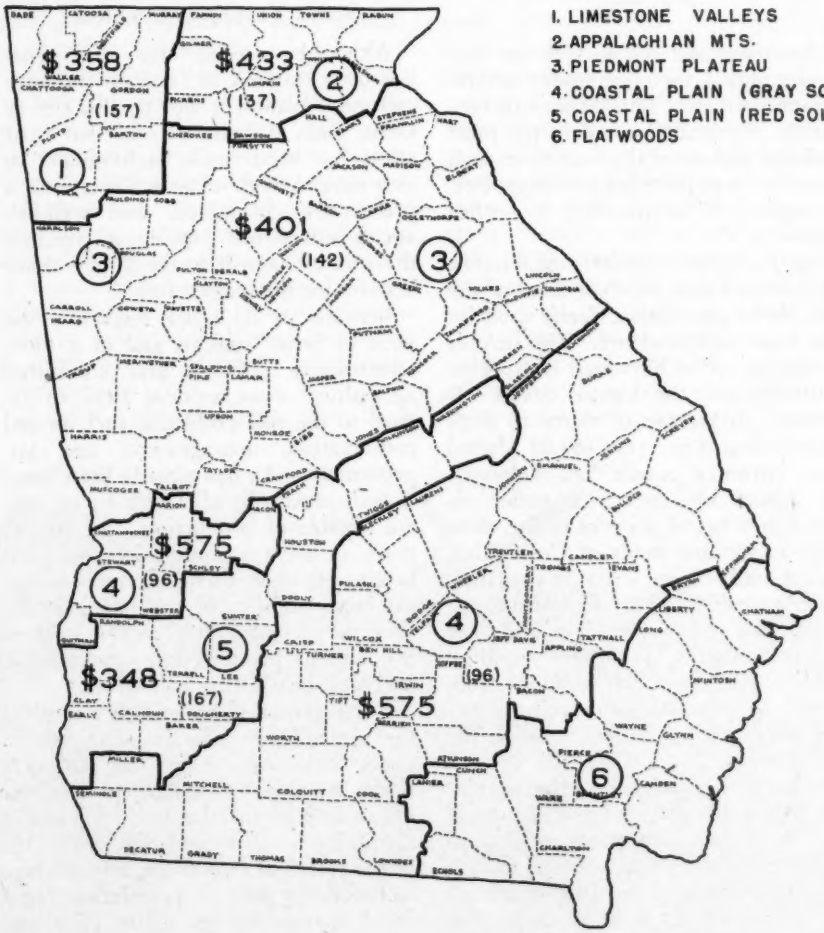

FIG. 1. GROSS RETURNS PER TON OF 60% MURIATE OF POTASH USED ON COTTON AND THE AVAILABLE POTASH IN THE SOILS OF THE VARIOUS SOIL REGIONS IN GEORGIA.

ALTHOUGH the quantity of available plant food in the surface soils of Georgia is constantly changing because of continued fertilization, leaching, erosion, and cropping, a survey based upon a sufficiently large number of samples may be expected to yield information of practical importance. During the past several years many soil samples have been collected from a large number of counties in the State by county agents, teachers of vocational agriculture, staff members of the Experiment Station, and other interested individuals. These samples have been analyzed for acidity, toxic substances, and plant foods such as potash, phosphoric acid, nitrogen, and others. Results of these analyses for pH, P_2O_5, and K_2O have been reported previously (1, 2).

The data reported previously for potash include only the average potash content of the soils for each county. Data of this nature are of value, but in addition, the percentage of samples found at the various levels of potash fertility may be of more practical importance. With this idea in mind, the data previously reported have been revised and retabulated for the purpose of getting at the more practical aspects of the potash fertility of Georgia soils.

In this report "available" potash is used to designate the exchangeable potash as determined by the method of Bray (3). Each value reported for results of field investigations represents the average of 18 replications of 1/20th-acre plots. These experiments were conducted with farmer cooperators by members of the staff of the Experiment Station. The gross returns for potash fertilizer were calculated on the basis of one ton of 60 per cent muriate of potash with seed cotton valued at 8¢ per pound. Cotton was selected as the crop to be used in the estimates for two reasons: first, because of the large acreage involved and the high cash value of this crop in Georgia; and second, because more data were available at this Station for correlating the laboratory data with actual field returns.

In the data reported in Figure 1, several thousand samples representing more than 1,700 locations were used. By making calculations on the basis of the soil regions of the State, it was believed that a reliable value could be obtained. These soil regions are (1) the Limestone Valleys, (2) the Appalachian Mountains, (3) the Piedmont Plateau, (4) the Lower Coastal Plain (mostly gray soils), (5) the Upper Coastal Plain (mostly red soils), and (6) the Flatwoods. Another region, the Fall-line between the Piedmont and Coastal Plains was eliminated from this study because of the small area involved. In addition the Flatwoods region was eliminated because only a few samples were obtained and only a small acreage is under cultivation in this region.

When the counties for which data are available are averaged according to soil regions, the results shown in Table 1, are obtained.

TABLE 1.—AVERAGE AMOUNT OF AVAILABLE POTASH IN THE SURFACE SOILS OF THE DIFFERENT SOIL REGIONS OF GEORGIA

Soil region	Samples obtained	Available K_2O per acre
	number	pounds
1. Limestone Valleys	175	157
2. Appalachian Mountains	371	137
3. Piedmont Plateau	927	142
4. Lower Coastal Plain (gray soils)	264	96
5. Upper Coastal Plain (red soils)	55	167

There appear to be no large differences in the available potash in the soils of the various regions with the exception of the Lower Coastal Plain (gray soils) which has a lower average than the others.

Yield data from 40 field experiments, conducted from 1939 through 1942 and tabulated in Table 2, indicate varying response of cotton to potash fertiliza-

tion, the amount of response depending upon the potash content of the soil. The soils are grouped into ranges of 0 to 140 pounds K_2O per acre representing low potash, 140 to 240 pounds K_2O per acre representing medium potash, and over 240 pounds of K_2O per acre representing a high level of potash. The low-potash soils show an average increase of 175 pounds seed cotton for 24 pounds of K_2O, the medium-potash soils show an average increase of only 34 pounds seed cotton for this amount of potash fertilization, while the high-potash soils indicate a slight decrease in yield with potash fertilization.

When the soils of each region were classified into these three groups, the results reported in Table 3 were obtained. About 79 per cent of the gray soils of the Coastal Plain were in the low-potash range while only slightly over 3 per cent of these soils were in the high-potash range. On the other hand, 45 per cent of the Limestone Valley soils were low in potash and 21 per cent were high. Using the increases for potash fertilization reported in Table 2 and considering the value of seed cotton at 8¢ per pound, the gross returns per ton of 60 per cent muriate of potash were calculated for the various regions, and these data were also shown in Table 3. The greatest profit was realized from the use of potash on the gray soils of the Coastal Plain and the least from the Limestone Valleys and red soils of the Coastal Plain. However, in all regions a large profit was realized. These values are presented graphically in Figure 1.

A somewhat more detailed study of the percentage of samples in the various potash ranges is given in Table 4. In this table the soils are classified into nine groups on the basis of their potash content. Instead of the wider range used above, a difference of 40 pounds of K_2O was used in this tabulation. From this table it will be noted that slightly over 52 per cent of the samples contained less than 120 pounds of K_2O per acre. About 34 per cent of the samples contained from 120 pounds to 240 pounds of K_2O, and the remaining 14 per cent contained over 240 pounds of K_2O. On the basis of 2,000,000 acres of cotton soils of Georgia, these figures would mean that more than one million acres of the cotton soils of Georgia are very deficient in potash and probably require an annual application of 48 pounds K_2O. On 34 per cent or 680,000 acres of the cotton land an application of 24 pounds K_2O would suffice, while on the remaining 250,000 acres

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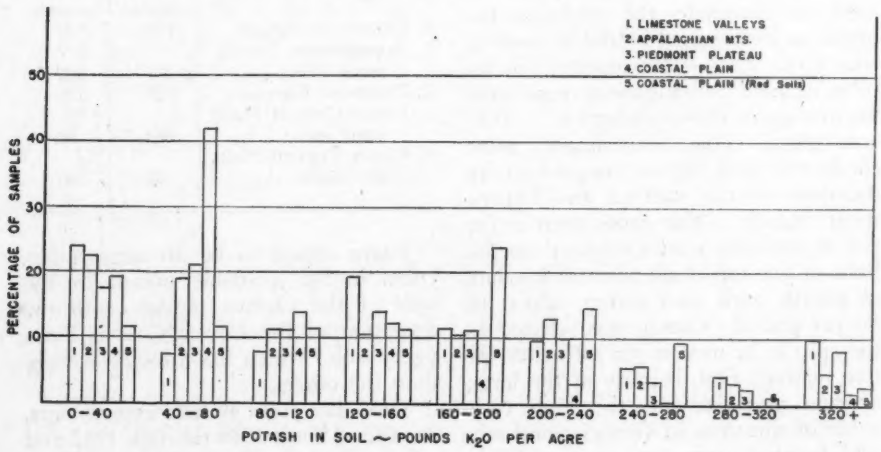

FIG. 2. PERCENTAGE OF SAMPLES OF DIFFERENT POTASH LEVELS IN THE VARIOUS SOIL REGIONS.

Conservation of water in farm stockpond near Paragould, Arkansas. Such ponds serve admirably for fish production.

Adjustment of Agriculture to Its Environment[1]

By H. H. Bennett

Chief, Soil Conservation Service, Washington, D. C.

THROUGHOUT the world there is acute need for a much better adjustment of agriculture to its physical environment, not only to gain a sorely needed increase in agricultural production but also to maintain a healthy agricultural economy, which is currently being threatened in many parts of the world by steadily continuing losses of basic soil resources in dangerously large proportions. This adjustment is vital, moreover, if we are to maintain in efficient production the most widely distributed and greatest possible area of productive land as a safeguard against ever-increasing costs in distribution of agricultural commodities. And most imperative of all reasons: We must make the adjustment if we are to maintain our ability to produce in any adequate way.

Such adjustment can be made. We have the knowledge; we need only the decision. Practical experience to date on a far-reaching scale in the United States shows that the adjustment is possible, practicable, and almost invariably of great and immediate advantage to the farmer and the nation.

A needed adjustment that I desire to emphasize particularly at this time has to do with the elimination of wasteful land-use practices, haphazardly applied,

[1] Taken from the Presidential address, 40th Annual Meeting, the Association of American Geographers, September 18, 1943, Washington, D. C.

and the widespread adoption, in their place, of various conservation practices scientifically fitted to the needs and physical characteristics of the land and the climatic environment. These conservation practices, applied in this way, at once safeguard the soil, increase its productivity, and conserve in the soil for productive use much rainfall normally lost as runoff.

This adjustment is of primary importance because it is the only way by which the agricultural plant of the United States, and of the world, can be kept in condition to support a permanent agriculture, and further, because it is the only way to get from the land anything like sustained, maximum yields.

Stated another way, there is an almost universal need for large-scale soil and water conservation operations to be carried out in accordance with the physical environment—if the world is to be adequately fed.

Problem in United States

To present the situation and the course of action with greater clarity, I will cite the problem in the United States, and what is being done about it, as our principal example and guide for the future.

Here in the United States we have used our fields with such prodigality that approximately 50 million acres of formerly cultivated land have been practically ruined by excessive erosion and cropping. This acreage has been abandoned for cropping, although some of it is in second-growth forest, some is used for wildlife, and some for limited grazing. Another area of about the same extent—50 million acres more—is in a condition nearly as bad and is about ready for abandonment insofar as further cultivation is concerned. On a second 100 million acres of cropland, about a fourth to three-fourths of the topsoil has been removed by erosion, yet thousands of farm families have been using these impoverished lands in an almost hopeless effort to make a living.

Two hundred million acres of cropland ruined for further practical cultivation, or severely damaged, is too much land wastage for any country, especially when there is no real need for wastage of any land at any time.

But similar destructive effects of erosion are practically world-wide. Nearly every country has been affected. A few countries have come close to a solution of the problem on certain lands, but most countries have done little or nothing in the direction of either preventive or remedial action.

There are approximately 4 billion acres now arable in the world on which the world must depend for food. These 4 billion acres must feed 2 billion people. That is two acres per person. Some countries have less than one acre per capita. Yet, some nutritionists say 2½ acres per capita of reasonably productive land are necessary to produce even a minimum adequate diet.

Only about a fourth of the 4 billion acres of the world's presently arable land is really good land. Most of it has been damaged by erosion and exhaustive cropping. In some regions, the land has been made so poor by centuries of cultivation and unwise use that most farmers expect no more than the pitiful return of a bushel or two of wheat per acre, and two or three bushels of corn. We have some land of this kind in the United States, and in various parts of the Western Hemisphere this is the prevailing situation in a number of agricultural areas. Moreover, our best estimates at this time indicate that from two-thirds to three-fourths of the world's immediately available cropland is subject to impoverishment or outright ruin by erosion.

There are some scattered areas of unused good land about the earth, but probably not nearly enough to meet world needs, even if problems of agricultural utilization and transportation and distribution could be solved. And besides, these lands too are largely subject to impoverishing erosion.

Clearly, this means that along with

the good and the non-erodible land, a great deal of land that is subject to erosion, as well as much lean soil, will have to be farmed if basic food requirements are to be met. And since the agricultural lands of the earth, handled as they have been handled, have not adequately met the world's food requirements in the past, the one alternative is to increase in the future the productive capacity of a large share of the cultivable area that is available now. To do this, we shall have to adopt new and better ways of farming.

Goal of Conservation Service

Such new and better ways of farming can be achieved through soil conservation farming and in no other way. Soil conservation farming everywhere calls for various major and minor adjustments and corrections in land use, but when it is put into effect, our experience on a widespread scale in the United States shows that two fundamentally important things are accomplished at the same time: Per-acre yields are increased and the soil is maintained in a continuing productive condition.

The work of the Soil Conservation Service was the first comprehensive, scientific, action effort in the world to achieve conservation of soil and water on a nation-wide scale. From the beginning, one cardinal principle dominated and guided this new program. Some called that principle idealistic and impractical; others failed to grasp its significance.

That basic, guiding principle was at the outset and is today as follows: Effective prevention and control of soil erosion and adequate conservation of rainfall, in a field, on a farm or ranch, over a watershed, or on any other unit or parcel of land, require the use and treatment of all the various kinds of land that occur within that area in accordance with the individual needs and adaptabilities or capabilities of each different parcel of land.

Like any precise statement of a rule, however, this principle requires some qualification.

First, the use and treatment of a given area of land must be determined not only by its physical characteristics, but also wherever possible by such considerations as available facilities, implements, power, labor, financial means, and even by the preference of the farmer, his ability to learn, and his willingness to try new methods. In other words, the treatment for conservation purposes must fit not only the needs and adaptabilities of the land itself but the needs and adaptabilities of the farmer as well.

The second qualification of the general principle is that each distinct tract of land to be treated should be considered and treated, wherever feasible, in its physical relation to the adjacent land—field, farm, or watershed—if there is any important physical relationship. The use and treatment of one area should provide as much protection as may be practicable for adjacent areas. For example, the management of lands on the higher parts of a slope should be determined in relation to downslope and downstream lands. Gullies that pour rock, gravel, sand, and infertile subsoil material of any kind out over lower-lying land should be controlled so as to protect downslope land which cannot otherwise be protected.

Outlets for surface runoff should be located with proper regard to the effect of discharging water and solid materials on adjoining lands. And, of course, the areas devoted to crops, grazing, and forest should individually and together constitute a sound economic unit, or as nearly so as may be practicable.

To carry out such a completely coordinated soil and water conservation program on a nation-wide basis requires a great deal of basic information for the most efficient blueprinting and planning of each farm and for the execution of the conservation job on the land. There are hundreds of different soils occupying varied slopes and subject to different intensities and amounts of rainfall and snowfall. No

two parcels of land are identical. Accordingly, each field—even each important part of a field, pasture, or woodlot—may require its own particular set of conservation measures. Conservation specialists have found that in most localities each farm, each ranch, is a special problem within itself.

The soil conservationist has at his command many different types of control measures for handling different types of problems. Completely effective conservation practices, however, have not been developed for all the numerous problems and combinations of problems relating to all the contrasting agricultural lands and practices of the nation. It is necessary to seek constantly for cheaper, sounder, and more efficient ways of conserving our soil and water resources.

Conservation Farming

Soil conservation is the youngest of the agricultural sciences. And so, from the very start, the practical field work has been supported by a program of soil and water conservation research through which new tools or methods of erosion control and better land utilization, as well as improvements on present tools and techniques, are being sought continuously. As fast as discoveries are made, they are carried to farmers cultivating lands to which the new methods apply. They are not stored in the darkness of files or buried in ultra-technical papers and bulletins.

Where good covers of dense vegetation and good stands of forest have been established and maintained, as on steep erodible land retired from cultivation, there usually is no further need for protection against erosion. The losses of soil under such protection are negligible, often too small to measure, and the runoff of rainwater is also much less.

For example, the average annual loss of soil under continuous corn on the principal regional soil at the Zanesville, Ohio, erosion station has been at the rate of 94.6 tons per acre, and the corresponding loss of water as immediate runoff has averaged 42.4 per cent of the total precipitation. Under grass, however, the corresponding losses have been only .02 of a ton of soil per acre (1/4,730 as much as under corn) and 4.8 per cent of the rainfall (or about 1/9 as much as under corn). During a single period of heavy rains—nearly 11 inches falling during January 1937 at the Zanesville station just before the record Ohio River flood—the measured losses of water as immediate runoff from a gullied corn field amounted to 94.7 per cent of all the rainfall, while only 31.5 per cent ran off from woodland, and 25.8 per cent from bluegrass.

Similarly, losses under good rotations, combined with terracing, or contouring, or strip cropping, or all of them, have been much less than under continuous corn and other wasteful ways of farming. These losses are from measured tracts of land, usually small tracts which nevertheless come pretty close to representing average conditions in this vast region of hill land characterized by shallow shale and sandstone soil. At any rate, these measured parcels of land constitute a part of the landscape upon which rain falls and courses away to the regional streams in amounts and rates that depend to a very large degree on how the farmer uses his fields, pastures, and woods.

Other measurements at the Zanesville station and at many other stations throughout the country show that conservation treatment continues to lessen runoff and soil loss regardless of how long or how heavily it rains and regardless of freezing and thawing. We have yet to find a piece of land that becomes so "saturated" with rainfall that it stops absorbing water. Continuing heavy rains do lessen, to varying degrees, the soil's capacity for infiltration of rainfall, but do not stop it. Unfortunately, this fact, only recently ascertained, has not yet got around nearly as widely as it should.

More and more is being learned about the control of erosion, the con-

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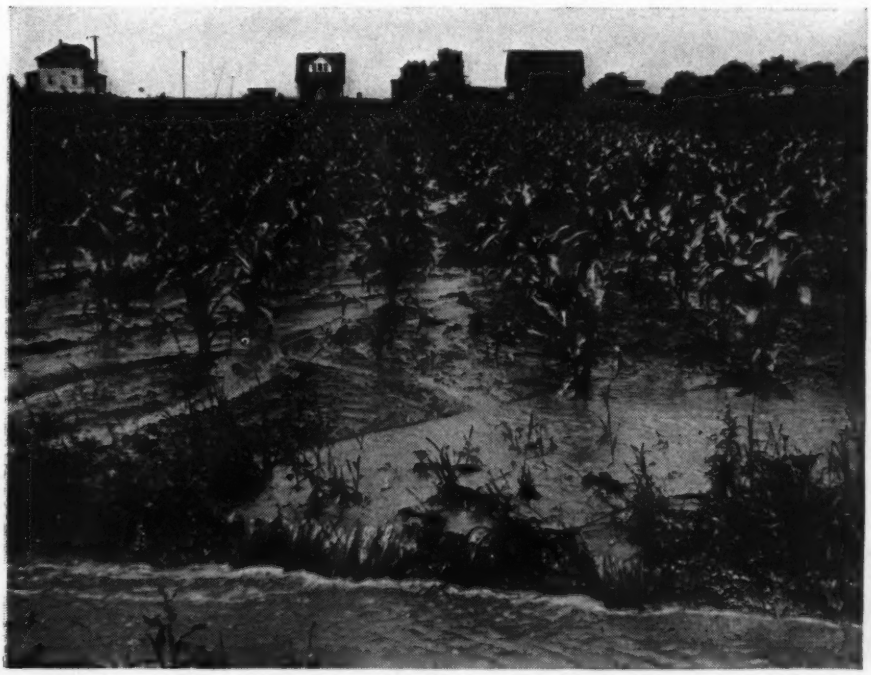
Above: The reservoir on Dan River near Danville, Virginia, is filled with the products of soil erosion.

Below: This Maryland field is losing its topsoil in the muddy water pouring off the land during a rain.



Above: Plowing without turning everything under, with part of the wheat stubble on top of the ground. This Montana field is pretty well protected from blowing.

Below: This steep Michigan slope called for a protective cover of vegetation—grass, legumes, or trees. Trees were decided on and were duly planted on the contour.

Above: Burning up the life substance of the soil, the stubble of a wheatfield, to make it easy to plow and kill grasshoppers. This is not conservation, but wasteful farming.

Below: Conservation of soil and water with contouring in the south-central prairie section, Oklahoma. Contouring is the central theme of soil conservation in this region.

Above: The result of complete treatment of the watershed of this Minnesota stream—fields, pastures, and woodlands.

Below: This southern California steep slope, which has about lost its topsoil, won't produce so much as a good crop of weeds.

The Editors Talk

Agriculture Post-war

With the end of the European phase of the war in sight, American industries are becoming more and more concerned with their post-war planning. Agriculture, America's major industry, while assured of an active demand for its products for some time after cessation of fighting, is beginning to take stock of its resources and the utilization of these resources not only during the next few years, but for the generations to come.

It is gratifying to us, therefore, to be able to present to our readers in this issue, Dr. Hugh H. Bennett's ideas as outlined in his article "Adjustment of Agriculture to Its Environment." We believe it also pertinent to re-emphasize here his six-point program for the next 10 years, proposed as "the nucleus for a sound, post-war rural works program," which he feels is capable of increasing food and fiber production in the United States by 20 per cent while simultaneously building up the soil and water resources of the Nation. New and more productive methods of land use have now been developed to such a degree of perfection in the United States, he says, that their widespread application to the farm and range lands of the Nation would result in vastly increased production, equivalent to that of a million new farms, without any net increase in the cultivated area of the country.

The six points:

1. An accelerated program of soil and water conservation, geared to complete within a 10-year period the application of all major, needed conservation measures on all the erodible lands of the country normally devoted to clean-tilled crops. This is an area of approximately 242 million acres, and does not include non-erodible land, pasture, or some 76 million acres of farm land normally devoted to thick-growing, soil-protecting crops such as grass, clover, and lespedeza.
2. Drainage of about 30 million acres of good land to improve the production of that part now in cultivation, and to bring into cultivation that part which is now too wet for tillage of any kind.
3. The rehabilitation, development, and better utilization of water resources on approximately 12 million acres, largely in sub-humid regions.
4. A broadened educational program throughout the school and university system of the country, and through other appropriate avenues, to acquaint children and adults with the importance, condition, and needs of their basic agricultural resources.
5. Rapid initiation of scientific investigation into the relationship between soil health and human health and nutrition, an approach to human betterment that has been neglected to an amazing degree by scientists almost everywhere.
6. Widespread development of needed water supplies and improvement of western range conditions through better grazing practices and livestock management to obtain maximum production on a sustained basis.

Steadily continuing losses of basic soil resources in dangerously large proportions, Dr. Bennett says, threaten our ability to maintain a healthy agricultural economy. Citing figures on soil losses in the United States, he declares that 50 million acres of once-productive cropland have already been ruined by erosion. Another 150 million acres have been severely damaged. The threat of erosion to food production is world wide, and only about a fourth of the four billion acres presently arable around the globe is really good land. These four billion acres must feed two billion people, although the rate of two acres per person is less than the amount which many nutritionists regard as necessary to provide a minimum adequate diet.

Dr. Bennett believes that the solution of this problem must lie in the elimination of the wasteful land-use practices now prevailing. He sees in a rapid and widespread shift to conservation farming methods, as outlined in his six-point program, a great increase in our agricultural production, the removal of the erosion threat to our agricultural economy, and the forestalling of increasing costs in the production and distribution of agricultural commodities. And most important of all, this adjustment must be made if agriculture is to maintain its ability to produce in any adequate way for demands which will be put upon it.

Fertilizer Use

The older a cropping system the greater the dependence on commercial fertilizers. Eastern and southern farmers are the big users of commercial fertilizer in this country. But the rest of the country is headed in the same direction, as we have pointed out from time to time.

Thus we find especial interest in a statement issued by Iowa State College agronomists. From field tests they have concluded that Iowa farmers can afford to increase their use of commercial fertilizer, from an estimated 67,500 tons in 1943, to 388,516 tons in 1944.

It is pointed out that in 1938 Iowa farmers used only 11,507 tons of commercial fertilizer. The trend since has been toward a constant increase, but the quantity used is still far behind that used in some other Corn Belt states. In 1938, for example, Iowa farmers spent 67 cents per $1,000 of cash income for fertilizer. In the same year Illinois farmers spent $2.50 per $1,000 of cash income, Missouri farmers spent $7.90 and Indiana farmers $24. It is added that "If Iowa's quota of fertilizer were allotted according to the most profitable response to applications in the field tests, the eastern half of the state would receive about 75 per cent of the total used."

In time all important cropping areas will be large users of commercial fertilizer, for the simple reason that farming won't pay without it. And in that connection it is encouraging that the fertilizer industry has made great improvement in two respects within recent years. Standardization of grades and higher testing mixtures are now the rule; and, secondly, a vast amount of practical information has been accumulated on the most effective use for different soils and crops. Fertilizer today is better and better employed than even just a few years ago.—*Chicago Daily Drovers Journal,* December 29, 1943.

Erratum:

Through a "slip" in the make-up of the December 1943 issue of this magazine, the wrong legend appeared under the picture at the top of page 25. This legend should have read: "A typical case of potash deficiency on White Dutch clover, as reflected in white spots on the borders of the leaves."

Farm Prices of Farm Products*

	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
1910–14 Average	12.4	10.4	69.6	87.6	64.8	88.0	11.94	21.59	....
1920	32.1	17.3	249.5	175.7	144.2	224.1	21.26	51.73	....
1921	12.3	19.5	103.8	118.7	58.7	119.0	12.96	22.18	....
1922	18.9	22.8	96.7	104.8	58.5	103.2	11.68	35.04	....
1923	26.7	19.0	84.1	104.4	80.1	98.9	12.29	43.69	....
1924	27.6	19.0	87.0	137.0	91.2	110.5	13.28	38.34	....
1925	22.1	16.8	113.9	171.6	99.9	151.0	12.54	35.07	....
1926	15.1	17.9	185.7	156.3	69.9	135.1	13.06	27.20	....
1927	15.9	20.7	132.3	114.0	78.8	120.5	12.00	28.56	....
1928	18.6	20.0	82.9	112.3	89.1	113.4	10.63	37.70	....
1929	17.7	18.6	93.7	118.4	87.6	102.7	11.56	34.98	....
1930	12.4	12.9	124.4	115.8	78.0	80.9	11.31	26.25	....
1931	7.6	8.2	72.7	92.9	49.8	48.8	9.76	17.04	....
1932	5.8	10.5	43.3	57.2	28.1	38.8	7.53	9.74	....
1933	8.1	12.9	66.0	59.4	36.5	58.1	6.81	12.32	....
1934	12.0	17.1	68.0	79.1	61.3	79.8	10.67	26.12	....
1935	11.6	16.1	49.4	73.9	77.4	86.4	10.57	35.56	....
1936	11.7	17.2	99.6	85.3	76.7	96.0	8.93	31.78	....
1937	11.1	19.9	88.3	91.8	94.8	107.1	10.36	30.24	....
1938	8.3	17.2	55.5	76.9	49.0	66.1	7.55	21.13	....
1939	8.7	13.6	68.1	75.4	47.6	63.6	6.95	22.17	....
1940	9.6	15.1	70.7	85.2	59.0	73.9	7.62	24.31	....
1941	13.3	19.1	64.6	94.4	64.3	84.0	8.10	35.04	....
1942	18.51	28.3	110.0	108.3	79.5	101.8	10.05	44.42	....
December	19.55	40.0	111.8	110.3	80.2	110.3	10.46	44.72	....
1943									
January	19.74	35.1	117.8	121.4	88.0	117.5	11.20	44.34	....
February	19.68	18.2	125.7	129.8	90.4	119.5	11.94	44.88	....
March	19.91	16.0	145.1	153.6	94.8	122.7	12.28	45.73	....
April	20.13	16.0	166.8	179.2	100.2	122.3	12.61	45.89	....
May	20.09	37.6	190.7	225.1	103.4	122.8	12.66	46.11	....
June	19.96	57.0	188.0	222.0	106.0	124.0	12.20	46.40	....
July	19.60	59.0	167.0	267.0	108.0	126.0	11.90	44.50	....
August	19.81	38.4	159.0	276.0	109.0	127.0	12.20	50.90	....
September	20.20	37.2	134.0	231.0	109.0	130.0	12.90	51.90	....
October	20.28	41.8	128.0	196.0	107.0	135.0	13.70	52.50	....
November	19.40	44.5	133.0	177.0	105.0	137.0	14.50	52.50	....
December	19.85	42.4	135.0	188.0	111.0	143.0	15.20	52.60	....

Index Numbers (1910-14 = 100)

1920	259	166	358	201	223	255	178	240	....
1921	99	187	149	136	91	135	109	103	....
1922	152	219	139	120	90	117	98	162	....
1923	215	183	121	119	124	112	103	202	....
1924	223	183	125	156	141	126	111	177	150
1925	178	161	164	196	154	172	105	162	153
1926	122	172	267	178	108	154	109	126	143
1927	128	199	190	130	122	137	101	132	121
1928	150	192	119	128	138	129	89	175	159
1929	143	179	135	135	135	117	97	162	149
1930	100	124	179	132	120	92	95	122	140
1931	61	79	104	106	77	55	82	79	117
1932	47	101	62	65	43	44	63	45	102
1933	65	124	95	68	56	66	57	57	105
1934	97	164	98	90	95	91	89	121	104
1935	94	155	71	84	119	98	89	165	126
1936	94	165	143	97	118	109	75	147	113
1937	90	191	127	105	146	122	87	140	122
1938	67	165	80	88	76	75	63	98	101
1939	70	131	98	86	73	72	58	103	109
1940	78	145	102	97	91	84	64	126	121
1941	107	184	93	108	99	95	68	162	145
1942	149	272	158	124	123	116	84	206	199
December	158	385	161	126	124	125	88	207	293
1943									
January	159	338	169	139	136	134	94	205	277
February	159	175	181	148	140	136	100	208	301
March	161	154	208	175	146	139	103	212	302
April	162	154	240	205	155	139	106	213	291
May	162	362	274	257	160	140	106	214	253
June	161	548	270	253	164	141	102	215	308
July	158	567	240	305	167	143	100	206	315
August	160	369	228	315	168	144	102	236	308
September	163	358	193	264	168	148	108	240	311
October	164	402	184	224	165	153	115	243	264
November	156	428	191	202	162	156	121	243	295
December	160	408	194	215	171	163	127	244	245

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Fish scrap, wet acidulated, 6% ammonia, 3% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.05	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	3.54	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.25	4.59	5.16
1924	2.99	2.44	5.87	5.02	4.41	3.60	4.25
1925	3.11	2.47	5.41	5.34	4.71	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.15	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.35	4.32	5.70
1928	2.67	2.30	7.06	6.63	5.28	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.69	4.61	5.72
1930	2.47	1.81	4.78	4.96	4.15	3.79	4.58
1931	2.34	1.46	3.10	3.95	3.33	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.82	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.58	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.84	2.67	3.27
1935	1.47	1.15	4.59	3.10	2.65	3.06	3.65
1936	1.53	1.23	4.17	3.42	2.67	3.58	4.25
1937	1.63	1.32	4.91	4.66	3.65	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.17	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.12	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.35	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.27	3.76	4.43
1942	1.74	1.41	6.11	5.77	3.34	5.04	6.76
December	1.75	1.42	5.68	5.77	3.34	4.86	6.53
1943							
January	1.75	1.42	5.68	5.77	3.34	4.86	6.53
February	1.75	1.42	5.83	5.77	3.34	4.86	6.53
March	1.75	1.42	6.30	5.77	3.34	4.86	6.53
April	1.75	1.42	6.29	5.77	3.34	4.86	6.53
May	1.75	1.42	6.29	5.77	3.34	4.86	6.53
June	1.75	1.42	6.30	5.77	3.34	4.86	6.53
July	1.75	1.42	6.30	5.77	3.34	4.86	6.71
August	1.75	1.42	6.30	5.77	3.34	4.86	6.71
September	1.75	1.42	6.30	5.77	3.34	4.86	6.71
October	1.75	1.42	6.29	5.77	3.34	4.86	6.71
November	1.75	1.42	6.29	5.77	3.34	4.86	6.71
December	1.75	1.42	7.39	5.77	3.34	4.86	6.71

Index Numbers (1910-14 = 100)

1922	113	90	173	132	117	140	142
1923	112	102	177	137	140	136	147
1924	111	86	168	142	145	107	121
1925	115	87	155	151	155	117	135
1926	113	84	126	140	136	129	139
1927	112	79	145	166	143	128	162
1928	100	81	202	188	173	146	170
1929	96	72	161	142	154	137	162
1930	92	64	137	141	136	112	130
1931	88	51	89	112	109	63	70
1932	71	36	62	62	60	36	39
1933	59	39	84	81	85	97	71
1934	59	42	127	89	93	79	93
1935	57	40	131	88	87	91	104
1936	59	43	119	97	89	106	121
1937	61	46	140	132	120	120	122
1938	63	48	105	106	104	93	100
1939	63	47	115	125	102	115	111
1940	63	48	133	124	110	99	96
1941	63	49	157	151	107	112	126
1942	65	49	175	163	110	150	192
December	65	50	162	163	110	144	186
1943							
January	65	50	162	163	110	144	186
February	65	50	167	163	110	144	186
March	65	50	180	163	110	144	186
April	65	50	180	163	110	144	186
May	65	50	180	163	110	144	186
June	65	50	180	163	110	144	186
July	65	50	180	163	110	144	191
August	65	50	180	163	110	144	191
September	65	50	180	163	110	144	191
October	65	50	180	163	110	144	191
November	65	50	180	163	110	144	191
December	65	50	211	163	110	144	191

Wholesale Prices of Phosphates and Potash**

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Kainit, 20% bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657	$0.655
1922	.566	3.12	6.90	.632	.904	23.87	....	.508
1923	.550	3.08	7.50	.588	.836	23.32	....	.474
1924	.502	2.31	6.60	.582	.860	23.72	....	.472
1925	.600	2.44	6.16	.584	.860	23.72	....	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537	.524
1927	.535	3.09	5.50	.646	.924	25.55	.586	.581
1928	.580	3.12	5.50	.669	.957	26.46	.607	.602
1929	.609	3.18	5.50	.672	.962	26.59	.610	.605
1930	.542	3.18	5.50	.681	.973	26.92	.618	.612
1931	.485	3.18	5.50	.681	.973	26.92	.618	.612
1932	.458	3.18	5.50	.681	.963	26.90	.618	.591
1933	.434	3.11	5.50	.662	.864	25.10	.601	.565
1934	.487	3.14	5.67	.486	.751	22.49	.483	.471
1935	.492	3.30	5.69	.415	.684	21.44	.444	.488
1936	.476	1.85	5.50	.464	.708	22.94	.505	.560
1937	.510	1.85	5.50	.508	.757	24.70	.556	.607
1938	.492	1.85	5.50	.523	.774	25.17	.572	.623
1939	.478	1.90	5.50	.521	.751	24.52	.570	.607
1940	.516	1.90	5.50	.517	.730	....	.573	....
1941	.547	1.94	5.64	.522	.779	25.55	.570	....
1942	.600	2.13	6.29	.522	.809	25.74	.205	....
December	.600	2.00	5.90	.535	.817	26.00	.210	....
1943								
January	.600	2.00	5.90	.535	.817	26.00	.210	....
February	.600	2.00	5.90	.535	.817	26.00	.210	....
March	.608	2.00	5.90	.535	.817	26.00	.210	....
April	.640	2.00	5.90	.535	.817	26.00	.210	....
May	.640	2.00	5.90	.535	.817	26.00	.210	....
June	.640	2.00	5.90	.471	.701	22.88	.176	....
July	.640	2.00	5.90	.503	.797	26.00	.188	....
August	.640	2.00	5.90	.503	.797	26.00	.188	....
September	.640	2.00	5.90	.503	.797	26.00	.188	....
October	.640	2.00	5.90	.535	.797	26.00	.200	....
November	.640	2.00	5.90	.535	.797	26.00	.200	....
December	.640	2.00	6.10	.535	.797	26.00	.200	....

Index Numbers (1910-14 = 100)

1922	106	87	141	89	95	99	....	78
1923	103	85	154	82	88	96	....	72
1924	94	64	135	82	90	98	....	72
1925	110	68	126	82	90	98	....	74
1926	112	88	114	83	90	98	82	80
1927	100	86	113	90	97	106	89	89
1928	108	86	113	94	100	109	92	92
1929	114	88	113	94	101	110	93	92
1930	101	88	113	95	102	111	94	93
1931	90	88	113	95	102	111	94	93
1932	85	88	113	95	101	111	94	90
1933	81	86	113	93	91	104	91	86
1934	91	87	110	68	79	93	74	72
1935	92	91	117	58	72	89	68	75
1936	89	51	113	65	74	95	77	85
1937	95	51	113	71	79	102	85	93
1938	92	51	113	73	81	104	87	95
1939	89	53	113	73	79	101	87	93
1940	96	53	113	72	77	....	87	....
1941	102	54	110	73	82	106	87	....
1942	112	59	129	73	85	106	84	....
December	112	55	121	75	86	108	85	....
1943								
January	112	55	121	75	86	108	85	....
February	112	55	121	75	86	108	85	....
March	113	55	121	75	86	108	85	....
April	119	55	121	75	86	108	85	....
May	119	55	121	75	86	108	85	....
June	119	55	121	66	74	95	80	....
July	119	55	121	70	84	108	82	....
August	119	55	121	70	84	108	82	....
September	119	55	121	70	84	108	82	....
October	119	55	121	75	84	108	83	....
November	119	55	121	75	84	108	83	....
December	119	55	125	75	84	108	83	....

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer materials‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash
1922.....	132	149	141	116	101	145	106	85
1923.....	142	152	147	114	107	144	103	79
1924.....	143	152	143	103	97	125	94	79
1925.....	156	157	151	112	100	131	109	80
1926.....	145	155	146	119	94	135	112	86
1927.....	139	153	139	116	89	150	100	94
1928.....	149	155	141	121	87	177	108	97
1929.....	146	153	139	114	79	146	114	97
1930.....	126	145	126	105	72	131	101	99
1931.....	87	124	107	83	62	83	90	99
1932.....	65	107	95	71	46	48	85	99
1933.....	70	109	96	70	45	71	81	95
1934.....	90	123	109	72	47	90	91	72
1935.....	108	125	117	70	45	97	92	63
1936.....	114	124	118	73	47	107	89	69
1937.....	121	130	126	81	50	129	95	75
1938.....	95	122	115	78	52	101	92	77
1939.....	93	121	112	79	51	119	89	77
1940.....	98	122	115	80	52	114	96	77
1941.....	122	130	127	86	56	130	102	77
1942.....	157	152	144	93	57	161	112	77
December..	178	158	147	92	57	154	112	79
1943								
January...	182	100	149	92	57	154	112	79
February..	178	162	149	92	57	155	112	79
March.....	182	163	150	93	57	160	113	79
April.....	185	165	151	95	57	160	119	79
May.....	187	167	152	95	57	160	119	79
June.....	190	168	151	93	57	160	119	69
July.....	188	169	150	94	57	160	119	74
August....	193	169	150	94	57	160	119	74
September.	193	169	150	94	57	160	119	74
October...	192	170	150	95	57	160	119	78
November.	192	171	150	95	57	160	119	78
December..	197	172	150	96	57	171	119	78

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* U. S. D. A. figures.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning with June 1941, manure salts prices are F. O. B. mines, the only basis now quoted.

**** The annual average of potash prices is higher than the weighted average of prices actually paid because since 1926 better than 90% of the potash used in agriculture has been contracted for during the discount period. From 1937 on, the maximum seasonal discount has been 12%.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Recommendations for Wartime in Arkansas," Ext. Serv., Univ. of Ark., Little Rock, Ark., W. E. Publ. No. 2, November 1943, Charles F. Simmons and Earl J. Allen.

"Commercial Fertilizers," Agr. Exp. Sta., New Haven, Conn., Bul. 476, Nov. 1943, E. M. Bailey.

"Tonnage of Different Grades of Fertilizer Sold in Delaware 1942," Dela. Exp. Sta., Dover, Dela., C. E. Phillips.

"Commercial Fertilizers for Minnesota in 1943-44," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., E. Pamphlet 118 Revised, October 1943, C. O. Rost and Paul M. Burson.

"Synthetic Manure," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 470, Aug. 1943, James P. Martin and Selman A. Waksman.

"Report of Analyses of Commercial Fertilizers Sold in New York State, Part I," Dept. of Agr. and Markets, Albany, N. Y., Bul. 343, July 1943.

"Wartime Crop Fertilization in Tennessee," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 265 (Rev.), Nov. 1943, H. E. Hendricks.

"Commercial Fertilizers in 1942-43," Agr. Exp. Sta., College Station, Texas, Bul. 639, Oct. 1943, G. S. Fraps, T. L. Ogier, and S. E. Asbury.

Crops

"Annual Report 1942-43," State Board of Agriculture, Dover, Dela., Quarterly Bul. 33(3), Sept. 30, 1943.

"Twenty-Seventh Biennial Report of the Department of Agriculture," Tallahassee, Fla., July 1, 1940 to June 30, 1942.

"Twenty-Third Annual Report 1942-1943," Ga. Coastal Plain Exp. Sta., Tifton, Ga., Bul. 36, July 1943.

"Small Grains in Georgia," Ga. Agr. Ext. Serv., Univ. System of Ga., Athens, Ga., Cir. 314, Sept. 1943, E. D. Alexander.

"Roses," Agr. Exp. Sta., Lafayette, Ind., Cir. 216(Rev.), Sept. 1943, E. R. Honeywell.

"Alfalfa-Brome Grass Silage for Dairy Cows," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 285, June 1943, J. W. Wilbur, R. K. Waugh, S. M. Hauge, and J. H. Hilton.

Soils

"Analyses of United States Soils, South Atlantic States," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., April 1943, J. S. Joffe and Adrienne B. Conybeare.

"Review of Principal Results, 1942," Soil Conservation Serv., So. Piedmont Cons. Exp. Sta., Watkinsville, Ga., May 15, 1943, B. H. Hendrickson, J. R. Carrekor, and W. E. Adams.

Economics

"Arizona Agriculture 1943," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 188, Feb. 1943, George W. Barr.

"Land Tenure in Arkansas III. Income and Changes in Tenure Status of Share Renters, Share Croppers, and Wage Laborers on Cotton Farms," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 438, June 1943, J. G. McNeely, Glen T. Barton, Trimble R. Hedges.

"Marketing the Illinois Apple Crop," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 497, Aug. 1943, J. W. Lloyd and V. A. Ekstrom.

"An Appraisal of Maximum Wartime Production Capacity in Illinois," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., AE-2094, July 30, 1943.

"Farm Tenure in Indiana by Type-of-Farming Areas," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Bul. 488, July 1943, G. G. Quackenbush and O. G. Lloyd.

"Prices of Tobacco in Different Parts of Kentucky," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 448, June 1943, Dana G. Card and James H. Clarke.

"Wartime Farm Plans," Dept. of Farm Economics, Agr. Exp. Sta., Lexington, Ky., Farm Ec. Miscl. 118, December 1942, Geo. B. Byers and R. H. Allen.

"Community Organization in Charles County, Maryland," Agr. Exp. Sta., Univ. of Md., College Park, Md., Bul. No. A21, Jan. 1943, Linden S. Dodson and Jane Woolley.

"An Economic Study of Land Utilization in Otsego County, New York," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., Bul. 791, March 1943, Alexander Joss.

"N. C. Farm Survey, 1942 Crops," N. C. Dept. of Agr., Raleigh, N. C., Jan. 1943.

"1944 Agricultural Outlook Charts," U. S. D. A., Washington, D. C., Oct. 1943.

An Agricultural Look at Costa Rica

(*From page* 19)

section of the country. It is good to remember in this connection that the rainfall in the country varies from one to six thousand mm. per year according to location. The washing-off or percolation of nitrates, soluble phosphates, calcium, and potash is of the greatest significance in diminishing fertility. So considerable is this loss that under certain circumstances, such as sandy soils not well protected by vegetation, the extraction of plant-food elements from the soil, which must be assigned to this particular reason, surpasses the amount that could have been taken from the same area by a very heavy-feeding or exhaustive crop.

The logical remedy for this important problem should be: first, proper selection of the plants to be cultivated in different regions, in such way as to discontinue from places where the rainfall is very heavy and the soils are rather sandy or open the production of those that need a thoroughly clean culture; secondly, substitution, whenever possible, of the "cover-crop" culture for "clean culture" in order to protect the soil from erosion and percolation, particularly during the months with heavier rains—not disregarding the necessary consideration and provision to avoid direct competition from the fast-growing, heavy-feeding cover crops over the cultivated or money crop, especially if it is perennial and has a woody structure, such as coffee. The practice here mentioned has been experimental with cocoa, coconuts, bananas, sugar cane, fruit trees, coffee, and others. With coffee, competition was prompt to appear, especially when the cover crops were legumes.

However, it was remedied by arresting the growth of the cover crop and the immediate fertilization of the cultivated one with available nitrogen, phosphorus, and potassium. The proportions used depended on the type of soil and condition of the plantation as well as the symptoms which, in a physiological or in a pathological manner, showed the competition. In many instances, it happened that the application of potassium alone was enough to solve the situation.

A Guernsey dairy herd on a farm pasture near the Capitol. The altitude here is 6,000 feet.

A third way to remedy this problem of soil exhaustion caused by percolation or washing-off is the improvement of its humus content as well as its supply of available plant-food elements by means of well-balanced fertilization.

Great importance as a cause of soil depletion in Costa Rica, and most especially in the dry sandy regions of the Pacific Ocean, needs to be attributed to the condemnable practice of clearing or cleaning the cultivable fields of native vegetable growth, or else from the remnants of a previous crop by means of fire. The damages, which are manifold, are evidenced particularly in the destruction of humus and organic matter in different states of decomposition, the volatilization of nitrogen, the lowering of the biological activities, and the destruction of certain favorable physical properties of the soils.

Still another cause of soil impoverishment, and unfortunately very common in Costa Rica, is the lack of crop rotation. The "corn after corn and always corn" policy is something that has done and is continuing to do tremendous harm to our agricultural life, and consequently should be banished forever.

It is ordinarily practiced in the production of all annual crops such as cereals, legumes, horticultural crops, potatoes, etc., and to its effects should be attributed the disequilibrium and diminishing productiveness of our soils as well as the appearance of many insect pests and many fungous diseases.

In concluding this brief study on some agricultural aspects and soil problems of Costa Rica, it should be added that although the actual situation of the industry is not very satisfactory for several reasons, some of which have been mentioned, once duly understood, perspectively planned, and technically managed, its flourishing future can be definitively established.

Available Potash in the Surface Soils of Georgia

(*From page* 22)

less than 24 pounds of K_2O are needed.

Figure 2 brings out in graphical form the data presented in Table 4. It is evident from an inspection of this figure that a higher percentage of samples is found in the low-potash range. The lowest percentage of samples appears to be found in the 260 to 320 range and the highest percentage in the 40 to 80 range.

In conclusion it may be said that the situation in regard to potash fertility in Georgia soils may be altered when data from a much larger number of samples are available. Nevertheless, it is believed that the data presented point to an urgent need for potash on cotton soils in this State. Even in the red soils of the Coastal Plain and in the soils of the Limestone Valleys where the lowest returns per ton of potash were obtained, a large profit has been realized from the use of potash on cotton. In addition it must be remembered that the values presented are averages, and in many cases soils may be much more deficient than represented in Figure 1. On the other hand, some of the soils may be amply supplied with potash. Probably the only way for a farmer to decide whether or not his soil is in need of potash will be by means of soil tests or from experience. In many cases the latter method of determining the potash fertility of a soil will be impractical and expensive. (Tables 2 and 3 on pages 40 and 41)

References

1. Georgia Experiment Station 53rd Annual Report, 1940-41, pp. 28-31.

2. Georgia Experiment Station 54th Annual Report, 1941-42, pp. 23-27.

3. Bray, R. H. A test for replaceable and water-soluble potassium in soil. Jour. Amer. Soc. Agron., 24: 312-316. 1932.

TABLE 2.—YIELD AND INCREASE IN YIELD OF SEED COTTON FROM POTASH FERTILIZER ON SOILS OF DIFFERENT POTASH FERTILITY. EXPERIMENTS CONDUCTED 1939 THROUGH 1942.

Available Potash in soil	Yield seed cotton per acre			Available Potash in soil	Yield seed cotton per acre			Available Potash in soil	Yield seed cotton per acre		
Lbs. K_2O per acre 0–140	No K_2O applied	24 lbs. K_2O applied	Increase	Lbs. K_2O per acre 140–240	No K_2O applied	24 lbs. K_2O applied	Increase	Lbs. K_2O per acre over 240	No K_2O applied	24 lbs. K_2O applied	Increase
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
50	208	299	91	145	567	658	91	250	419	426	7
50	393	570	177	150	648	803	155	250	876	907	31
50	758	941	183	150	717	747	30	280	1142	1174	32
50	452	609	157	175	381	427	46	305	1167	1134	−33
50	157	188	31	175	826	904	78	320	1185	1128	−57
50	702	695	−7	180	1400	1424	24				
50	436	604	168	180	1317	1441	124				
55	595	780	185	185	1378	1329	−49				
60	617	801	184	185	1576	1562	−14				
65	392	765	373	185	1562	1542	−20				
65	694	788	94	200	954	939	−15				
110	850	1022	172	200	1353	1334	−19				
115	570	849	279	210	888	891	3				
120	676	1022	346	210	774	816	42				
120	495	600	105								
120	522	985	463								
130	1222	1349	127								
130	1229	1251	22								
Average	609	784	175	Average	1024	1058	34	Average	958	954	−4

TABLE 3.—GROSS RETURNS* PER TON OF 60 PER CENT MURIATE OF POTASH IN THE VARIOUS SOIL REGIONS OF GEORGIA

Soil Region	Percentage of soil samples at various levels of available K_2O			Gross returns** per ton of 60% muriate of potash for the percentage of soils at each of the three levels of potash fertility in the various regions			Weighted average returns per ton of 60% muriate of potash
	Pounds of avail. K_2O in the soil			Pounds of avail. K_2O per acre in the soil			
	0–140	140–240	Above 240	0–140	140–240	Above 240	
	per cent	per cent	per cent	dollars	dollars	dollars	dollars
Limestone Valleys	45.1	33.7	21.2	315.70	45.83	−3.39	358.14
Appalachian Mountains	56.6	28.6	14.8	396.20	38.90	−2.37	432.73
Piedmont Plateau	51.4	31.9	16.7	359.80	43.98	−2.67	400.51
Coastal Plain (Gray soils)	78.8	17.8	3.4	551.60	24.21	− .54	575.27
Coastal Plain (Red soils)	40.0	50.9	9.1	280.00	69.22	−1.46	347.76

* State average for gross returns per ton of 60% muriate of potash on soils testing 0–140 lbs. K_2O—$700; 140–240, $136; Above 240, −$16.
** Calculated from the results of fertilizer tests (Table 2) with cotton fertilized with 24 pounds K_2O per acre and the price of seed cotton at 8c per pound.

TABLE 4.—NUMBER AND PERCENTAGE OF SAMPLES FOUND AT VARIOUS LEVELS OF POTASH FERTILITY

Region	Potash level of soil—pounds K_2O per acre																				Total samples
	0–40		40–80		80–120		120–160		160–200		200–240		240–280		280–320		320+				
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%			
Limestone Valley	37	23.9	11	7.1	12	7.7	30	19.4	18	11.6	15	9.7	9	5.8	7	4.5	16	10.3			155
Appalachian Mountains	81	22.4	68	18.8	40	11.0	34	9.4	38	10.5	47	13.0	22	6.1	13	3.6	19	5.2			362
Piedmont Plateau	156	17.3	190	21.1	101	11.2	126	14.0	101	11.2	92	10.2	33	3.7	24	2.7	77	8.6			900
Coastal Plain (Mostly gray soils)	47	19.3	103	42.2	34	13.9	29	11.9	16	6.6	8	3.3	2	.8	...	....	5	2.1			244
Coastal Plain (Red soils)	7	11.5	7	11.5	7	11.5	7	11.5	15	24.6	9	14.8	6	9.7	1	1.7	2	3.2			61
Total	328	19.1	379	22.0	194	11.3	226	13.1	188	10.9	171	9.9	72	4.2	45	2.6	119	6.9			1,722

What's in that Fertilizer Bag?

(*From page* 15)

A soil reaction of about pH 6.5 is, generally speaking, satisfactory for most farm crops. A value of pH 4.5 represents the extreme acidity for agricultural soils below which most crops will scarcely grow at all.

Many state laws require that the fertilizer manufacturer shall guarantee the acidity or basicity of the fertilizers. The fertilizer bulletins in such states report on this quality of all fertilizers sold in the state.

Until quite recently most of the mixed fertilizers sold in this country were acid-forming; that is, they increased the acidity of the soil. This was due to the increased use of sulfate of ammonia and other ammonium salts in formulating mixed fertilizers. Forty years ago about 90% of the nitrogen used in fertilizers was derived from animal and vegetable sources; today less than 20% is from these sources. Research has shown that for every unit of nitrogen furnished by sulfate of ammonia there is required the equivalent of 107 pounds of lime as calcium carbonate to neutralize the residual acidity developed. For every unit of nitrogen from tankage or acid fish only about 2 pounds of lime are needed to neutralize the acidity formed. Many other organic materials develop a basic residue in the soil. That is why the fertilizers of a generation ago were not acid-forming. Sodium nitrate develops a basicity or alkalinity in the soil; for every unit of nitrogen it develops a basicity equivalent to that of 36 pounds of calcium carbonate. This is due to the sodium which it contains. Sodium is an alkaline material.

Many manufacturers are now formulating their mixed fertilizers in such a way as to prevent the development of acidity in the soil. Such fertilizers are said to be neutral or non acid-forming. A fertilizer can be mixed so that in the soil it will have a "basic reaction"; that is, it not only will not develop acidity, but it will have a basic character sufficient to neutralize some soil acidity. Such a fertilizer is called "basic."

Potato fertilizers, on the other hand, are formulated so as to be slightly acidic in order to help maintain an acid reaction in the soil to prevent the development of the potato scab fungus.

Since every farmer should use enough lime in his rotation to correct soil acidity and furnish calcium as plant nutrient, the acidity of modern fertilizers should not cause grave anxiety. The savings achieved in manufacturing our present complete fertilizers and passed on to consumers make it possible for any farmer to buy sufficient lime for his soil needs and still pocket a considerable difference. Liming is very important on all farm soils and should always be done prior to the application of fertilizers. Soils that are properly limed will make fertilizers more efficient.

Formerly the materials used in formulating fertilizers contained a relatively low plant-food content. The fertilizer so made was low in plant food. The first 50 years of the industry saw little change in the plant-food content of mixed goods. Then, with the commercial development of nitrogen fixation following the first World War, a remarkable improvement occurred. The new source of nitrogen supplemented or replaced the organic nitrogenous materials—cotton-seed meal, dried blood, and animal tankage. Nitrate of soda and sulfate of ammonia remained the same, but among the newer fixed-nitrogen materials we had ammonia liquor, urea, ammonium nitrate, and ammonium phosphate, all of which have a much higher nitrogen content than the organic materials formerly used almost exclusively. These changes influenced formulation practices and introduced many new grades, especially in the midwest, the northeast, and the Pacific coast sections. There is a tendency to classify fertilizer grades ac-

cording to plant-food content: those containing 16-20% total plant food are considered as ordinary or standard-analysis mixtures; those containing more than 20% are classed as high-analysis; while those with less then 16% are designated low-grade.

The National Fertilizer Association recently conducted a consumer survey. The survey reveals that a large number of farmers still buy fertilizer on the basis of cost per ton, thus ignoring all the information given by the fertilizer industry and state and federal agricultural authorities which was designed to teach consumers how to evaluate and purchase wisely on a basis of "cost per pound of plant food" and not on "cost per ton of fertilizer."

A recent South Carolina bulletin shows how a farmer who can calculate the cost per pound of plant food can save a lot of money. It cited a comparison between 3-8-3 and 4-12-4. The ton cost of the 3-8-3 was $23.67 and it furnished 280 pounds of plant food. The 4-12-4 fertilizer cost $28.13 per ton, but to furnish 280 pounds of equivalent plant food in the 3-8-3, only 1,400 pounds of the 4-12-4 were required which cost only $21.09, therefore making a saving of $2.58.

A Texas bulletin cites cost for equivalent amounts of plant food supplied in fertilizer of three different concentrations. The comparisons are tabulated as follows:

	Tons	*Analysis*	*Cost*
Equivalent	1.67	3-10-3	$48.13
Plant	1.25	4-12-4	41.27
Food	1.00	5-15-5	39.22

You see from this table that the more concentrated fertilizer, 5-15-5, containing 25 units of plant food, cost $8.91 less for an equivalent amount of plant food than the 3-10-3 analysis which contains only 16 units of plant food.

A Vermont bulletin instructs its farmer readers to appreciate the fact that the cost of plant food decreases as the concentration of the fertilizer increases. It cites examples. At the time of publication the average cost in Vermont was 10.6 cents per pound of plant food in fertilizers having 15 to 17 units, 9.5 cents in those having 20 to 21 units, and as low as 6.5 cents per pound in those having 38 to 44 units.

These facts are not hard to understand. It does not cost any more to manufacture and distribute the more concentrated fertilizer. One ton of 5-10-5 can be trucked for the same price as a ton of 3-8-3. The bag cost is the same. By spreading these costs over a larger number of units of plant food per ton, some real money is saved. While the cost per ton or per pound is not the only criterion in choosing between fertilizers, it certainly is a factor that should always be considered before buying.

Having said the above, I want to emphasize here this other viewpoint, that a better gauge may be *What is the cost per acre?* The latest figures from the U. S. Department of Agriculture reveal that the American farmer spends for fertilizer only 2.37% of his total income. Considering that the return on fertilizer is at least $3 for every dollar spent, this expenditure is hard to understand. Compared with farmers in European countries the expenditure is very low.

To be sure of getting the most plant-food for his money, one should:

(1) Buy those fertilizer grades recommended by the state authorities, as those grades will usually supply plant foods at the lowest cost per unit or per pound, as well as conform to the latest information on the best plant-food ratios for the particular soil and crop conditions involved.

(2) Buy fertilizers on the basis of cost per unit or cost per pound of plant food rather than on cost per ton alone.

(3) Buy fertilizers with as high a total percentage of plant food as possible under local conditions, since basically this should reduce costs because of fewer bags, less freight on smaller tonnage, and less handling. It is assumed that such fertilizers figure lower in cost per pound of plant food, and that one is equipped to distribute ac-

curately the more concentrated grades.

In recent years there has been a trend to double-strength fertilizers. Under present emergency conditions there may be a shortage of double or treble superphosphates, as well as some of the more concentrated nitrogen materials. Some manufacturers temporarily must use portions of raw potash salts, called manure salts, containing around 25% potash. For the present it may be necessary to produce more of the ordinary strength fertilizers.

In my files, I found the following clipping taken from an editorial in the "National Stockman and Farmer" of about 1915. The message is as true today as it was then:

"Every acre of land that has ever been productive may be made so again. This is the message of hope that agricultural science brings to the man who owns a run-down farm. Methods of improvements may vary according to circumstances, but the use of commercial fertilizers is the first essential. Fertilizers to make something grow on this barren land, manure from the crops grown, lime, legumes, and tillage—these are the essentials in the rebuilding of a soil. Properly managed, the returns more than cover the cost of restoration, and the owner has $100 land instead of worthless land after a few years. Is it worth while? It is, and no prejudice or parsimony should delay the start, which calls for the outlay of money for fertility that comes in bags. If the improverished soils of this country are to be made productive by the generation that owns them now, fertilizers must be used to start the process. Nature will restore fertility in the course of time, but this generation will not be here to see the end of her effort. Man's method is quicker and more profitable to him and to the country."

Adjustment of Agriculture to Its Environment

(*From page* 26)

servation of rainfall, and the better utilization of land in general—both through practical farm experience and research. A number of long strides forward have been made in this direction recently and other important possibilities seem close at hand.

For example, the perennial lespedezas and kudzu have wrought profound changes in the use of much severely eroded land in many parts of the southern states. Lands which a little while ago were considered too poor or too steep or too erodible to farm—even some areas that were so gullied they could not be plowed at all—are now producing, with some fertilizer and care to get them started, excellent hay or grazing with these valuable crops. And these crops are holding the soil, retarding runoff, reducing the effects of silting, and generally raising farm income.

Turning soil upside down—according to the traditional way of plowing which has been one of the main functions of the turning, or moldboard plow—is not generally one of the wisest steps in agriculture. It puts the vegetative material, including grain stubble, corn stalks, grass, and legumes, as well as weeds or any other vegetative material, anywhere from 6 to 12 inches underground and turns fresh, loose earth to the top where it is exposed to the ravages of wind and rain.

When grass or other vegetative litter is lodged deeply underground, it cannot protect the surface. Fresh, loose soil exposed to the sun, wind, and rain on top of the ground is a rank invitation to trouble. The sun bakes the

life out of the unprotected soil, at least temporarily. When it is dry, it falls loose and lifeless about the plow, so that wind can readily blow it away. And when any kind of rain heavier than a drizzle falls on it, soil washing results—sheet erosion and gullying—with an aftermath of muddy rivers and silt in reservoirs, harbors, and ditches. Where the slope is steep, there may be such a rush of water and soil downhill that crops go along with it. Also, the downhill wash of water and topsoil carries away both the added fertilizer and the natural plant food in the soil, along with the whole body of the soil. Still, there will be uses for the moldboard plow, as for plowing up water-diversion ridges, terraces, and drainage ridges ("lands"), and for use on certain soils of essentially level surface.

Throughout the country, technicians of the Soil Conservation Service and other agriculturists are striving to develop as rapidly as possible the new field methods and machinery precisely adaptable to the erosion control and production needs of each varying agricultural locality. Steadily, all this soil conservation work is taking the form of a new agriculture in our country—an agriculture based primarily on soil conservation farming methods. And to date our progress with it is pacing the rest of the world.

Conservation farming puts first things first by attending to the needs of the soil—by seeing to it that the starting-off place, the base, is put into a condition of productive health and kept that way. Any other approach, no matter what it may be, always has and always must lead to eventual defeat through downfall of the base—the land.

Food is not produced just with written agreements, international or otherwise. Food in good output is produced only through the wise use of agricultural land. Yet from the standpoint of available resources, there is such a shortage of favorable agricultural land in the world that even before this war started, millions of people were always hungry and other millions lived under the almost constant threat of famine.

There is a widespread and a dangerous misconception about the world's productive soil resources. Many people think of the world as an amazingly vast place, abundantly stocked with rich land, much as frontiersmen of an earlier day in America believed there was a boundless reservoir of productive land beyond the western horizon.

Too many people have lost sight of the fact that productive soil is essential to the production of food. Apparently this fact has been so obvious and has been taken for granted so long the human race has just about arrived at the point of ignoring it. It should neither be taken for granted nor ignored, because there is no longer an abundance of productive land around the world. The somber truth is the area of good soil on earth is becoming more and more limited. This means that the world's food production capacity is likewise becoming more and more limited.

Advantages of Conservation

With the area of arable land already subject to grave limitations in many parts of North America and with further losses of productive acreage in prospect, it becomes doubly important to recognize now the production advantages, and the protection advantages, of comprehensive, scientific soil conservation work when undertaken widely.

Conservation farming on many thousands of farms through the United States, producing all kinds of crops, has resulted in an average increase in per-acre yields of at least 20 per cent. In some instances the increase has been 40 per cent, 50 per cent, 100 per cent, and more. And this has been accomplished with very little additional labor, fuel, time, money, or machinery.

Twenty per cent increased production is the equivalent of adding a sixth farm for every five farms now in cultivation. Applied to the nation, it

would provide a vast additional amount of food, fiber, and vegetable oils.

Through its nation-wide cooperative conservation program of research, demonstration, and extensive work on the land, the Soil Conservation Service has spear-headed the technical program of development and application of new and improved measures for the control and prevention of erosion, for conservation of rainfall, for drainage, and for other measures of sound land use. The Service is helping individual farmers and groups of farmers to adopt these measures over the widest possible area.

The Soil Conservation Service is not a lending agency; it makes no benefit payments of any kind. Essentially, it is a corps of trained, experienced land specialists organized to work with the farmer out on the ground to provide security to the land and the farmer, to build soil productivity, to strengthen the individual, the community, the nation.

Flexibility in Program Required

If there were some simple remedy for the ills of the land that could be applied as a standardized treatment indiscriminately, the job of soil conservation would be relatively easy. But there is as much variety in erosion as in the landscape of the country. Control methods that work wonders on Southeastern gully-torn cotton country may do more harm than good on the wheatlands of the Great Plains, and vice versa. Even on neighboring farms, land problems are seldom identical. And in those localities where much of the precipitation is in the form of snow, special measures are required for safeguarding farm and range land.

For these and other reasons, an effective program of soil and water conservation must be sufficiently flexible to meet the varying physical conditions and economic circumstances.

The specific land treatments used and recommended by the Soil Conservation Service—of which there are 59 major types of treatment—may vary from one valley to the next, from farm to farm, and even from field to field. Before any work is done, each farm or ranch is carefully analyzed, the whole of it, both as a piece of land and as a business enterprise.

In making the physical analysis to determine productivity, needs, etc., field men of the Service carefully note the exact lay of the land, the quality of the soil, the degree of erosion damage, and the erosion hazards of every acre of every field, woodlot, pasture, and wasting gully. As accurately as possible, these conservation technicians determine which lands can be cultivated under good farm practices without excessive loss of soil and rainfall; which lands need the protection afforded by special crop arrangements, special tillage practices, or structural installations; and which ones require a permanent cover of trees, grass, or other protective vegetation.

The next step is to work out with the farmer a farm blueprint for practicable operation, based on the ground information acquired. This the technician does, not indoors around a table, but out in the fields, pastures, woodlots, gullies, and abandoned and idle areas working alongside of the farmer himself.

In some instances, this new arrangement may not fit the farmer's pocketbook. It may call for more meadow crops than he actually can make use of and not enough soybeans or corn; it may involve other changes he cannot afford to make. If so, it is not a good arrangement in a practical sense, and it must be adjusted, if it can be, to meet family needs, market opportunities, etc. Purely from the conservation standpoint, however, farm arrangements based on physical land conditions and needs are ideal. The closer the operator can approach such a plan for his farm or ranch, and still make a good living, the more stable and productive his land will be, and the surer his income, over the long run and usually beginning the very first year the soil conservation work is done.

Drawing up a satisfactory land-use and land-protection farm blueprint is only part of the job. The other part involves the actual application of the plan to the land. Each parcel of land, even under the new use, generally needs some special practice or treatment for adequate soil protection, especially if it is sloping land subject to excessive washing or sandy soil subject to blowing. Excessively steep or unproductive croplands, for example, may be earmarked for a permanent cover of grass or trees; farm forests may be planned where grass is not paying out or is failing to hold the soil; gullied areas may be turned into grass-covered or legume-covered waterways, or farm sanctuaries for animals and birds, or valuable pastures of kudzu. Croplands generally should be farmed in rotation, usually on the level, and sometimes in strips. On the more erodible slopes, terraces are frequently needed for added protection. Pastures need to be limed, fertilized, cleared of weeds, and grazed with caution to improve the growth of grass. Woodlands need to be fenced to keep out livestock, they need to be protected from fire, and managed according to scientific principles of forestry. These are only a few of the 59 basic erosion-controlled practices that may be called into use across the Nation.

Permanent Agriculture

And, so, we have a new arrangement of fields, pastures, meadows, and woods, with a new system of use and protection that safeguards the soil and fits the land as nature made it and as man uses it. Under such a plan, soil conservation is not just an incidental bit of the mechanics of farming; it becomes an essential part of the whole business of making a living from the land, and is the only way by which we may have permanently productive land for a permanent agriculture for continuing support of the nation.

A preliminary conservation-needs survey, recently completed by the Soil Conservation Service by extending the results obtained from detailed land use capability surveys to 127 basic land resource areas, indicates that of the approximately 398 million acres of cropland, including temporarily idle land (1940 census), 40 million acres of the 1939 cropland should be retired to permanent grass or forest and that the remaining 358 million acres are physically suitable for cultivation.

Productive Soil Is Life

With respect to potential arable land in farms, the survey shows that there are 132 million acres of plowable grassland (such as plowable pasture, grassed areas in the Plains, meadows, and certain wet lands) and 34 million acres of plowable woodland, slash, and scrub. This does not mean that the wise thing to do would be to plow up immediately all such grassland or all of the arable woodland, since there is need for great quantities of beef, milk, butter, and wood, especially during this wartime period. Other considerations also enter into the matter of bringing about efficient adjustments in these various categories of land included in farms.

With respect to conservation practices, determinations of the areas needing one or more of the 59 principal practices employed in the United States have been made. These show, for example, that approximately 122 million acres need contour cultivation and 31 million acres need drainage; 260 million acres require crop rotations and 33 million acres seasonal cover crops; 96 million acres would be benefited by terracing and 90 million acres by strip cropping.

These soil conservation activities in the United States show that fundamental readjustments between land use and land capability, on a far-reaching scale and in wide geographic variety, are not only technically and economically possible and necessary, but are socially essential. Yet, what has been achieved so far is but a beginning on the job ahead—a job which must be carried on vigorously without delay.

Everyone is concerned in this; none can escape its implications. Productive soil is life and productive soil is vanishing with each passing year. The farmer, the banker, the legislator, and scientist; the teacher, the preacher, the welder, and clerk; all have a personal stake in the speed and thoroughness with which this nation, and every other nation, moves to the task. Generations yet unborn will curse or praise us, according to our actions with respect to this problem in the years immediately ahead.

A Six-Point Program

I propose for the next decade a six-point program of agricultural adjustment to physical environment to which I believe all informed men can readily subscribe:

1. An accelerated program of soil and water conservation, through soil conservation districts, as determined by the condition and use-capabilities of the land itself. Such a program should be geared to complete within a 10-year period the application of all major, needed conservation measures on all the erodible lands of the country normally devoted to clean-tilled crops, grains, soybeans, flax, cowpeas, and rice; that is, on approximately 242 million acres (not including about 76 million acres of farm land normally devoted to thick-growing, soil-protecting crops, exclusive of pasture, such as grass, clover, and lespedeza). As a necessary support of this program, a detailed physical inventory of the nation's land resources, showing their capabilities for use, should be completed at the earliest possible date.

2. Drainage of about 30 million acres of good land to improve the production of that part now in cultivation and to bring into cultivation that part which is now too wet for tillage of any kind. Much of this land is in drainage districts and most of it has been cleared for cultivation. (This drainage work would help speed up a needed shift away from cultivation on an equivalent or larger acreage of steep, erodible upland which should go out of cultivation and into a permanent protective cover of trees, grass, or legumes.)

3. Rehabilitation, development, and better utilization of water resources on approximately 12 million acres, largely in sub-humid regions.

4. A broadened educational program throughout the school and university system of the country and through all other appropriate avenues for the dissemination of information to acquaint children and adults alike with the importance, condition, and needs of their basic agricultural resources.

5. Rapid initiation of scientific investigation into the relationship between soil health—with particular emphasis on security against erosion—and human health and nutrition. This approach to human. betterment has been neglected to an amazing degree by scientists almost everywhere.

6. Widespread development of needed water supplies and improvement of western range conditions through better grazing practices and livestock management. Under modern conservation practices for range lands, maximum production on a sustained basis is possible.

The vigorous prosecution of such a six-point program would increase food and fiber production in the United States by approximately 20 per cent. Stated another way, the carrying out of this program would add to our agricultural production plant a sixth farm for every five farms now in production, or an added production capacity equivalent to that of a million new farms—without any net increase in the cultivated area of the country.

Further, it would provide the nucleus for a sound, post-war rural works program. And in addition to its tremendous wartime and post-war benefits in terms of production and permanently protected soil, such a program would have a timeless value for human welfare far beyond our present ability to realize or estimate.

Where Do We Stand With Fertilizers?

(*From page* 12)

Fink, working in Maine, reports green weight yields of a ladino-timothy mixture as follows:

TABLE IV.

Treatment	*3-yr. Average*
1. 10 T.M. + Super, 60 lbs. P_2O_5	5.2 Tons
2. 80 lbs. P_2O_5 + 80 lbs. K_2O	4.67 Tons
3. No treatment	3.53 Tons
4. 40 lbs. N + P & K as in 2	6.60 Tons

These yields are for the first cutting, or hay crop, and do not include the yields later in the three seasons when the land was pastured.

The author points out that while nitrogen is not needed to maintain a ladino-timothy stand, it does markedly increase the yield of the first cutting. As a matter of fact, satisfactory stands of ladino were maintained in all the plots except that which was untreated.

The amount of phosphoric acid, (80 pounds per acre annually) according to the author, is more than the crop removes from the soil, but a similar application of potash is 75 pounds less than that taken out annually. Since the planting was made on a soil with considerable potash reserve, future recommendations for this element may have to be increased.

From the work reported, which is but a fraction of that which has been done with hay crops, it is easy to see that with a potash shortage or even a scarcity which would eliminate its use on hay crops classed in group B, serious effects would be noted immediately so far as legume production is concerned.

A good deal of effort was expended in the 1930's upon the improvement of permanent pastures. Work started by the National Fertilizer Association was pursued in many states to determine the effect of fertilizers on old pasture sods. The story told by these trials reflects much of the data which has been discussed above with hay crops. The type of response secured was colored by the existing vegetation or by the vegetation that was induced to enter the stand because of the kind of fertilizer applied.

Average results tell the story for an average pasture but not for specific ones. For example, very heavy soils which will support dense stands of wild white clover will respond more to applications of potash and phosphoric acid, while on the lighter soils on which grasses predominate, a greater relative response will be secured from nitrogen.

It seems worth while, because so much effort has been expended in this direction, to summarize this work here. For this purpose and since the treat-

This is the type of pasture that can be developed with adequate fertilization, grass and clover in fairly equal amounts in the sward.

ments were identical (and the results quite similar), data for Maine, (9) New Hampshire, (10) and those published by the National Fertilizer Association (11) have been averaged.

TABLE V.

Treatment	*Yield, Pounds Dry Matter per Acre*	*Yield, Pounds Protein per Acre**
None	1065	145
P	1322	199
LP	1444	236
LPK	1752	299
LNPK	2500	450

* Averages for Maine not included in protein results.

These data cover a large number of pastures and indicate the relative response for adding an element or substance to the previous treatment. Perhaps the data are more valuable for pointing out the reason why so many permanent pastures are relatively worthless than for gaining a judgment as to fertilizer response. If they do mean anything in respect to this, it is that no one substance but a combination of all is necessary for maximum improvement.

Thousands of acres of permanent pasture have been improved by top-dressing largely as a result of the stimulus of work of this sort. One research worker in New England has pointed out that the cheapest feed for dairy cattle is obtained from untreated permament pastures. This is true, without a doubt. But it is also true that the cheapest purchased feed is usually that which is bought with "fertilizer applied to a good pasture sod."

And we do not mean to leave the impression that top-dressing permanent pastures is the answer to the whole pasture problem. High-producing herds need more intensive feeding than a permanent pasture will produce and over a longer period, particularly through the middle of the summer. For this purpose ladino and other clovers, along with timothy and other high-yielding large grasses enter the picture.

It would be ideal, in summarizing an article of this kind, if we could say in evaluating the elements that all have an equal value or that one is responsible for 48 per cent, another for 32 per cent, and another for the remainder of crop increases. The need for fertilizer balance is so great and the effects of fertilizers and lime are so interrelated that actual percentages had best be left to the imagination.

Not all the crops which we have here in New England have been discussed. Vegetables and fruit, corn and many other crops would enter the picture in a complete treatise on this subject. Nitrogen appears to be the paramount need for fruit yields, phosphorus for large corn yields, and yet a certain balance is required here as it is for vegetables and other crops.

From what we have so far reported, the prospect of a possible potash shortage in relation to demand is not a happy prospect. It would be serious for the potato crop if this substance were not available in adequate supply. Dairy crops too, which, as we have previously pointed out, fall into the B group, will suffer from a potash shortage, especially ladino and other clovers which are so vital at this time for high milk yields. Growing legumes is our best method of offsetting the grain shortage. Hence any hindrance in producing them is a positive handicap, particularly in view of their great need.

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(11) Progress Report, Feb. 1931, N. F. A. J. B. Abbot, et al.

Victory Vows

(*From page* 5)

but they recall what Lincoln once said on that topic, and hereafter they will carry munitions with the fuse lit. It isn't just because they won't trust Europe or imperialism—it's because they won't trust themselves to grow indifferent again. Look what it got us into!

My next hop is over into the educational field. In my campus town there lies a field of about fifteen acres which was a military camp in the War Between the States. It presents a different picture today in some ways. In 1861-65 and later in the Spanish war, the soldiers did no "book work" and had no kind of training except that of loading and firing guns and obeying their officers. Today, this arena is often the scene of squads marching to classrooms with books galore under their arms, for knowledge of technical and even theoretical subjects is a requirement of high-power global strife. In meeting this urgent problem of hustling out recruits to meet terrific demands, taking callow youth full of gas-gadding and whims, and steady them into mature experts—our dawdling old college routine has been upset rudely. The result will be, as the lads insist, that in the future we streamline our institutions of learning somehow so as to give students the benefit of the quick route to known goals. Lots of useless clutter and redtape, duplication, delay, and fruitless effort will be done away with, so that the kids who join up with the army of the educated will not take so long to get their "shoulder straps." It will save many a farmer's and day laborer's hard-earned dollars spent on loans to sonny or sister, and ease the pathway of the kid obliged to earn his room and board.

Won't this new deal we should expect in college systems after the war do something to rid us of prejudice against "bookish" folderol? Maybe our farm courses also can be jacked up and oiled and geared to furnish more trained plowmen and less of something else with a semi-agricultural tinge, and do it in as little time as it took to make Sam Brown's boy into a navigator or a trajectory expert.

So here once more we get a glimpse of the vista that victory opens for us, not just to educate the morons on some cocoanut isle, but to make life more fair and understandable as well as more enjoyable, right back here in the well-known "sticks." (Of course I don't advocate drafting everybody for higher learning. That doesn't make sense either in or out of a war.)

Next, I sashay into the organization pasture. Here picking and grazing has been green for some and thin for others, depending on how hard and fast the membership was roped and hog-tied, financially and mentally. I refer to economic special privilege blocs and not to fraternal societies and academic groups.

ONE universal unrest is stirring these days and that is to make representative government truly representative and answerable to an understanding people, and not just a tool and a pawn for some talented fellow with lots of push and no overload of scruples. For as any ninny who knows his pressure groups knows, they are usually run by an inner circle of good fellows, who in turn take their cue from the master mind at the controls.

It doesn't take a Lippmann or any other sage to tell us folks out in the hinterlands that we have been misled and misrepresented and misinterpreted, and that our official agents in the legislative business have been bullyragged and bamboozled by some of the organization lobbyists.

I can remember when laborers and farmers lacked any voice in the halls of legislation or any bold and resourceful pleaders. Nobody wants to go back

to those fumbling days either. But some of us bull-headed guys back home have been quietly taking polls of opinion and cross currents of the views held by the folks who pay the expenses of the lobbies. To me it is not strange, but to some gullible ones it may be, that the rank and file of membership in trade or profession or occupation very often deny the attitudes attributed to them by their clever spokesmen. If you want proof, do a little sleuthing yourself in the wake of some publicity appeal and proclamation issued to congress by these mental magicians. Find out if the guys whose names were used were in the same frame of mind.

Most of the trouble from war-time squabbling on the economic front has arisen from such sources. Defense and destiny look like dollars and doughnuts to numerous self-maintained lobby leaders. Their organizations are not alive enough or courageous enough or don't have enough personal gumption to insist that if a lobby is kept to represent them that it does so. I know one state organization (without naming the field) which has its programs and resolutions actually whittled out before hand by ukase from the Washington lobby. By imposing its will on this and other state forums, the shrewd spokesman can point to such prophetic phrases with pride as proof of his genuine testimony. You cook it up in canned sauce of your own manufacture and then serve it as fresh country gravy. How the legislators gobble it too!

OF course we are going to continue to have lobbies and economic societies after the war, but for Pete's sake let's run them and not let them run us! This calls for a change of attitude backed by the mailed fist, maybe special delivery mail too! It's one sure way to clear the air for a free America.

I see my time is almost out and my share of the depleted paper supply is almost used up. I intended to inveigh and decry for a page or two on post-war art and literature, maybe the movies, and a few other entertainments. This must be postponed.

About all I have left on my agenda are class prejudice and international amity. But with only a few paragraphs reserved, I am unable to extend my "talent" fittingly in either direction, were it possible that I had anything safe to advance.

This business of settling class prejudice in one essay, even by such a w. k. intruder as myself, seems impossible. I am aware that this is a question that breeds more two-faced hypocrites than almost any social problem you can trot out. I've heard fellows cuss Hitler for rank treatment of races and creeds and then in the next breath make careful exceptions of what they might agree to with limitations in this country.

I CONFESS frankly that I lack courage or knowledge to whip right into this mess and disturb your cozy evening. I can't solve it anyhow. Maybe all of us together will find it a devilish bother to equalize racial opportunity without equalizing everything else everywhere anytime. It's too big a stump for a man with mental rheumatiz to jump over this late in life. I want something done, but I'll be darned if I know how or what. I guess you are on my side of the fence too. Let's be honest and courageous enough to say we don't know, and not pester the dickens out of audiences with quack remedies for it.

As for that other bogey of post-war nightmares, internationalism and world fraternity, I've lived too long in the narrow confines of the Midwest to get a load of it balanced right on my shoulders. I sincerely want to be a little brother (not bother) to all of the countries you can mention. I want to keep off their corns and I ask them to respect my lumbago. I won't trade them spavined colts or do them dirt. I hope they won't do that to me, in return for lend-lease. Therefore, in the tattered frame of mind I am in, all I can do to them is what I do for you—Happy New Year and Quick Victory!

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The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

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Tomatoes (General)
Asparagus (General)
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Better Corn (Midwest) and (Northeast)
Fertilize Pastures for Better Livestock (Pacific Coast)
Of Course I'm Interested (Pastures, Canada)
Meet the Family (Canada)

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HOT STUFF

Some American and British soldiers were looking at the molten lava inside of Mt. Vesuvius. An American remarked:

"Looks hot as hell."

An Englishman mumbled under his breath: "You Americans have been everywhere."

"How did you get that bump on your head?"

"My wife threw a vase at me."

"Why on earth didn't you duck?"

"I did, but she allowed for it."

Private: "See that sailor over there annoying that girl?"

M.P.: "Why, he's not even looking at her."

Private: "That's what's annoying her."

Applying for his citizenship papers, Gino was doing all right until he came to the questions about the American flag. "What is it," asked the Judge, "that you always see flying over the Courthouse?"

"Peejins!" confidently replied Gino.

COMFORT GREATER THAN PRIDE

Kindly Old Lady: "You say you've been on the force eight years? Why haven't you some service stripes on your sleeve?"

Cop: "I don't wear them. They chafe my nose."

Sergeant (on rifle range): "This new bullet will penetrate nearly two feet of solid wood, so remember to keep your heads down."

The ship had entered New York Harbor. On board was one colored soldier. As the ship passed the Statue of Liberty there was absolute silence, when suddenly the colored boy broke the silence by remarking: "Put your light down, honey, I'se home."

GET THIS

My lady, be wary of Cupid
And list to the lines of this verse;
To let a fool kiss you is stupid,
To let a kiss fool you is worse.

It was a wet banquet, with the exception of one guest. His glass of milk was furnished, but enroute to him some wag poured in a stiff shot of gin. The exceptional guest sipped the milk, smacked his lips, then gulped down the whole glassful. Wiping his lips gratefully, he murmured in admiration and awe, "Some Cow!"

"Did your garden do well last summer?"

"No, every time my husband started digging he found a lot of worms, so he would quit and go fishing."

Real Estate Salesman: "Would you like to see a model home?"

Prospect: "Glad to, what time does she quit work?"

Percival's love affair fell through. His lap was bow-legged.

Draftee: "Do you think they'll ever send me overseas, doctor?"

Examining Physician: "Not unless we're invaded!"

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50 West Broad Street, Columbus 15, Ohio

Free! This handsomely-illustrated 24-page booklet is based on the film and is filled with full-color pictures taken from the film. *It is yours for the asking!*

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EDUCATIONAL FILMS AVAILABLE

Save That Soil

A 16mm., sound, color film depicting the early South, the results of the one-crop system, and the reclamation and conservation of Southern soils through the use of legumes and modern methods of soil management.
Running time, 28 min. (on 1200-ft. reel).

Other 16MM. COLOR FILMS AVAILABLE

Potash in Southern Agriculture
In the Clover
Bringing Citrus Quality to Market
Machine Placement of Fertilizer
Ladino Clover Pastures
Potash from Soil to Plant
Potash Deficiency in Grapes and Prunes
New Soils from Old
Potash Production in America

We shall be pleased to loan any of these films to agricultural colleges and experiment stations, county agricultural agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible) and period of time of loan.

For additional information write:

AMERICAN POTASH INSTITUTE, INC.
1155 Sixteenth Street **Washington 6, D. C.**

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